

ASCENT Combo I/O

Technical Reference Manual

Ethernet/Wireless/Serial

Distributed and Peer-to-Peer I/O



Copyright Notice

Ascent Combo I/O Module

Technical Reference Manual

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In This Manual...

This manual provides the technical hardware information required for system design and installation of an Ascent Combo I/O module.

If you have just purchased an Ascent Combo I/O module, we hope that you are as pleased using it as we have been developing it.

If you are reading this manual looking at a future purchase, we hope that you will consider an Ascent Combo I/O module when you have an application that needs I/O expansion and telemetry that goes beyond just simple I/O.

Support

If you have questions or need help with an application, we hope that you'll take advantage of our free technical support. Simply call us at:

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Overview

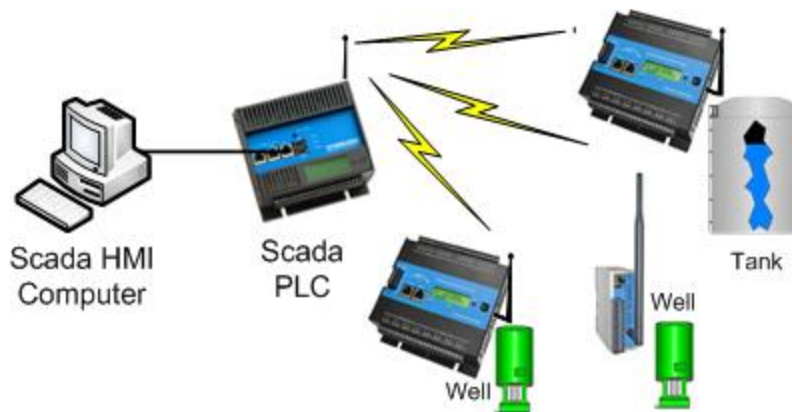
Ascent Combo Input/Output (I/O) modules can be used to add I/O capacity to a programmable controller or PC, serve as distributed I/O in a SCADA or DCS system, and/or operate as a standalone setpoint/pump controller. Two or more Ascent modules can provide a “mirrored” peer-to-peer I/O link where analog and discrete inputs are replicated as analog and discrete outputs on opposite sides of a communications link.

Ascent I/O modules come with a high-speed Ethernet communications port, and an additional RS-232/RS-485 serial port (for external radios, modems and HMI panels) and may be ordered with a built-in spread spectrum radio. All three ports operate independently and can communicate simultaneously. Ascent I/O modules support “bridging” between communications ports, allowing devices on various ports to be accessed from the other ports (for example, a serial or wireless device can be accessed via the Ethernet port) eliminating the need for and cost of external translators and bridges, extra radios, etc.

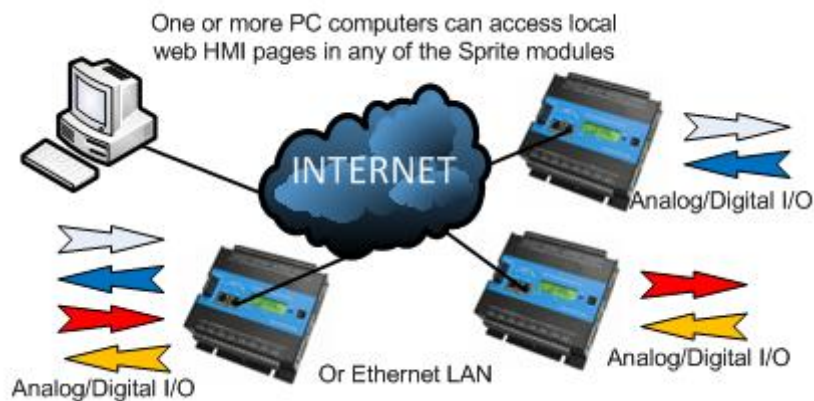
Ascent I/O modules also come with an on-board 4 line by 20 character HMI for basic configuration, data display and user interaction.

Ascent I/O is smart, eliminating the cost of external hardware devices and software, and solving many of the problems that can crop up with competitive systems. Configurable digital and analog input filtering, non-volatile high-speed digital and analog totalization, runtime and rate calculation, flexible scaling, and a built-in web HMI are just a few examples.

Ascent I/O modules can operate both as slaves that only communicate when talked to by another (Master) device, and as Masters that initiate message transactions. As a Master, a Ascent I/O module can be configured to send I/O information periodically, and/or when there is a change in state or level. Multiple Ascent modules can send to a single Ascent or Ascent I/O module that acts as an I/O concentrator. Any Ascent module can serve as a repeater to extend the range of wireless SCADA systems.



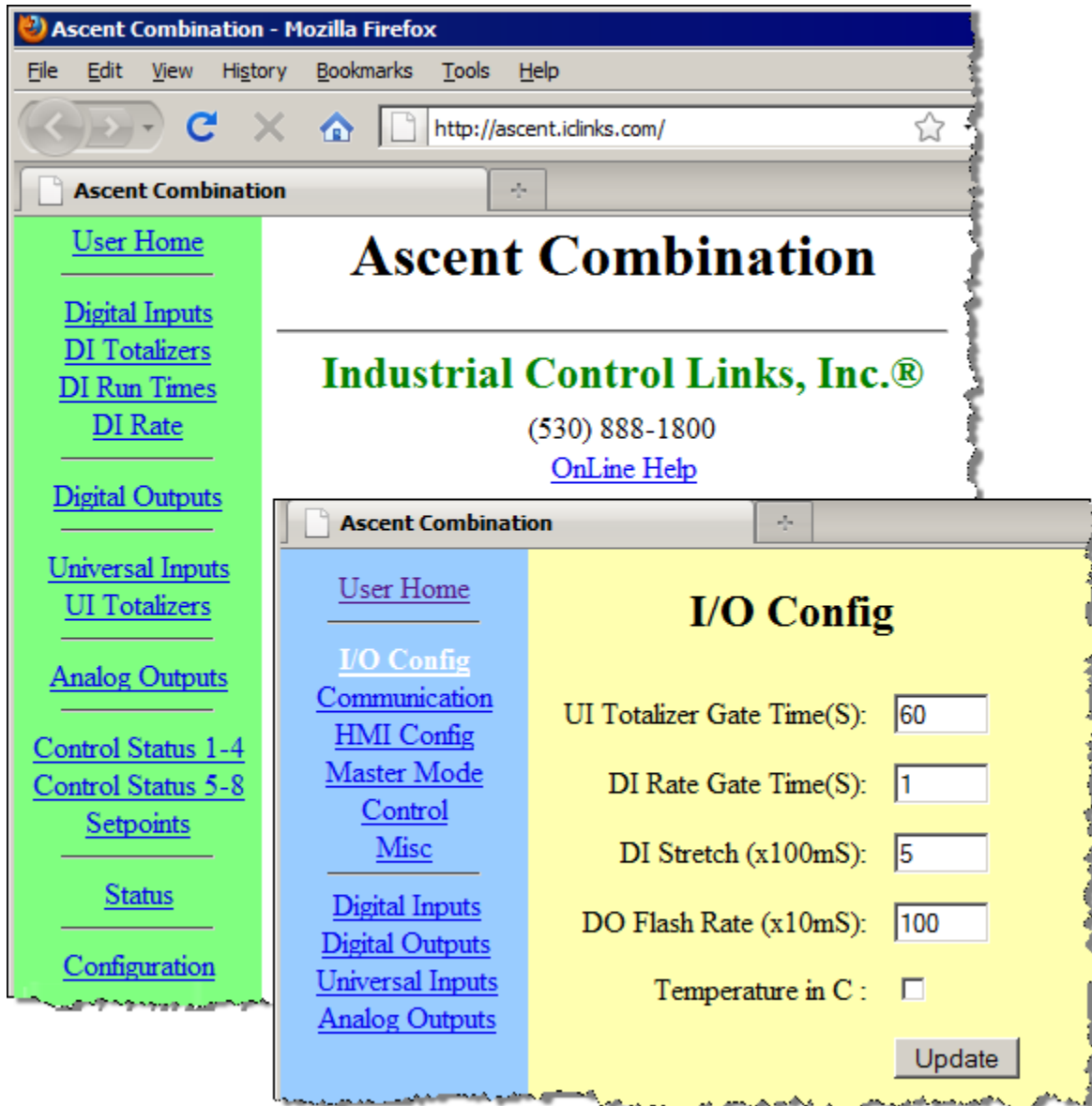
Municipal Water SCADA System With Remote Sprite



Industrial Process and Production Monitoring System

Ascent I/O modules may be configured to significantly reduce power consumption for solar and battery operated systems. Smaller solar panels and batteries translate into lower system costs. Ethernet interfaces can automatically power off when not used, analog loop power can turn off automatically between analog measurements, radios can be powered down when no messages are being sent, internal power supplies can automatically shut down when not required, and status indicator LEDs can be shut off when they are not needed.

Ascent I/O modules have both configuration and user web pages with separate access controls. The configuration web pages are used to set up the operation of the modules using any standard web browser. The user web pages are configurable to display select types of information with scaling and tag names to provide a user friendly interface, also using any standard web browser.



Besides the built-in web interface, a small HMI panel is also available (Viewpoint Express) that can be used in place of or in addition to a PC. The Viewpoint Express comes standard with an Ethernet interface, but is also available with a serial interface, making it possible to remotely locate the HMI panel via a serial wireless link. It may be panel mounted, or surface mounted in the included duplex outlet box.

Ascent Combo I/O Module



Viewpoint Express HMI with included junction box and mounting tabs

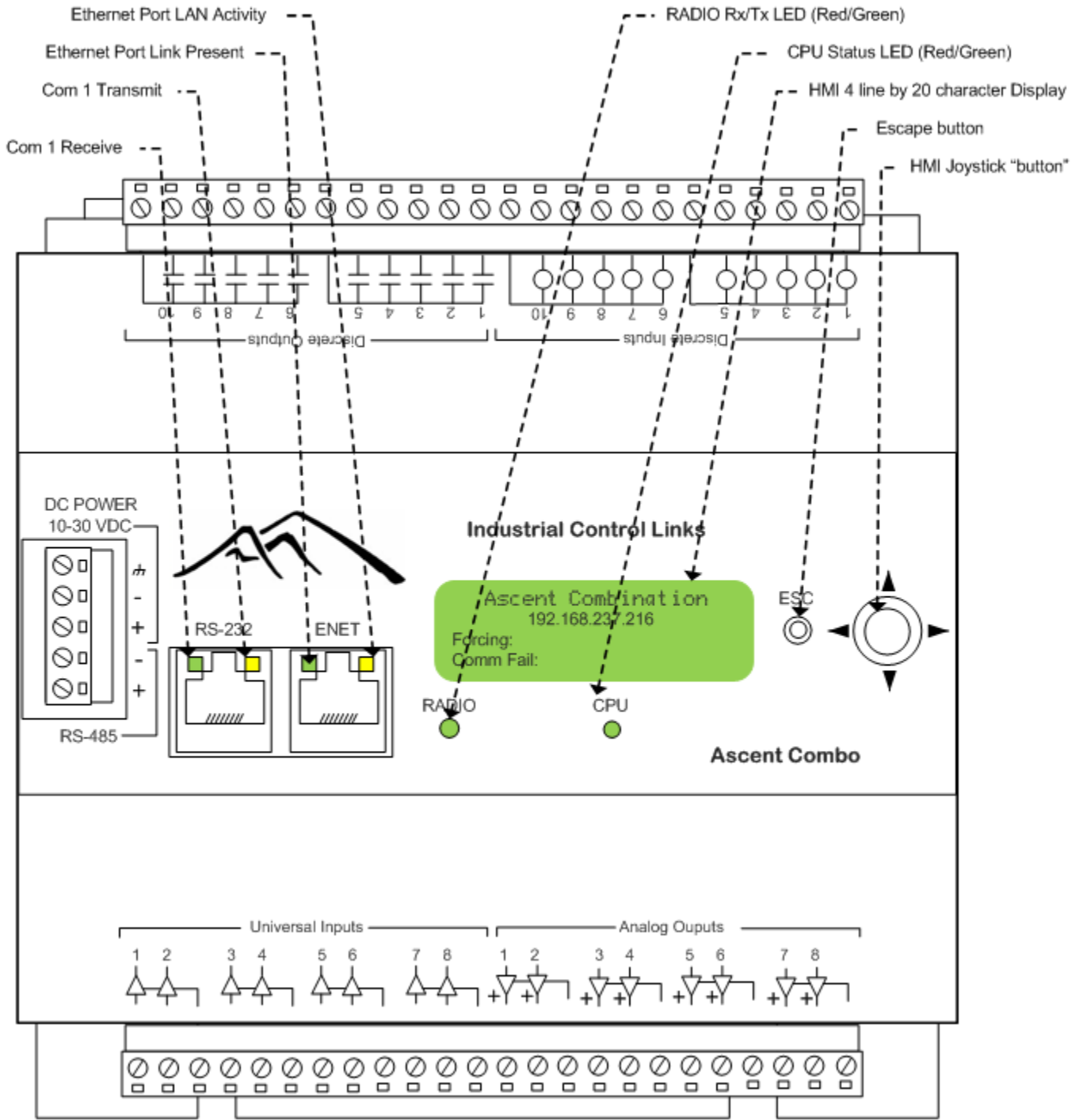
Third-party HMI panels that communicate via Modbus or DF1 can also be used, but they must be configured to read/write registers in the Ascent module. The Viewpoint Express comes ready-to-run.

Most importantly, Ascent I/O modules are designed for extreme reliability, featuring an extended temperature rating for outdoor use without fans and filters, and a full 3-year factory parts and labor warranty.

Operation

Status Indicator LEDs

Ascent Combo Input/Output (I/O) modules have LED Status indicators to show the state of the digital inputs and outputs, the state of the Ethernet and optional serial port, and the module (CPU) and optional internal radio signal status. The locations of these indicators are shown in the diagram below:



Ascent Combo I/O Module

Ethernet Status LEDs	The Ethernet Port has two LED indicators labeled “LINK” and “ACT”. The Link LED is lit when the Ascent module is connected to an Ethernet device. The ACT (Activity) LED flashes whenever a message is received or transmitted through the Ethernet port.	
Com 1 Status LEDs	Indicate transmit and receive data on both the RS-232 and RS-485 interfaces.	
	Green	Receive
	Yellow	Transmit
Radio Status LED	Indicate transmit and receive data on internal radio option.	
	Green	Receive
	Red	Transmit
CPU LEDs	Indicates several statuses of the Ascent unit:	
	Slow Flashing Green	Normal
	Fast Flashing Red	Comm Fail (Master mode only)
	Slow Flashing Red	Forcing is being utilized
	Fast Flashing Green	Boot Loader mode
HMI Display	4 row by 20 character display for configuration, data entry and data display.	
HMI Controls	HMI controls are used for simple configuration, examining data and data entry.	
	<u>Key</u>	<u>Navigation mode</u>
	ESC	Exit current page
	Right (Joystick Button)	Next page
	Left	Previous page
	Up	Up to next link
	Down	Down to next link
	Enter (center)	Select link
		<u>Edit Mode</u>
		Exit current edit
		Select Next digit to edit
		Select Previous digit to edit
		Increment current digit
		Decrement current digit
		Confirm value

Inputs and Outputs

Ascent Combo Input/Output (I/O) modules have a symmetrical mix of analog and digital inputs and outputs:

10	Digital Inputs
10	Digital (relay) Outputs
8	Universal Inputs
8	Analog Outputs

Each type of I/O has configurable features that simplify implementation of control and monitoring systems. These features are described in the following sections.

Ascent Combo I/O in Brief

Digital Inputs

Type:	Optically isolated 12 to 24V to DI common
Forcing:	ON, OFF, none
Signal Conditioning:	Inversion, Filtering/Delay, Stretch
Measurements:	Runtime, Totalization, Rate
Communications:	Individually settable to trigger message transmission

Digital Outputs

Type:	Relay contacts with shared common, up to 3A per contact total of 15A per common connection
	Forcing: ON, OFF, none
Functions:	Flash, Pulse Width Modulation (PWM) – One-shot or Frequency Generation Output Holdoff (rapid cycle protection)

Comm Fail States: ON, OFF, HOLD (individually settable by channel)

Universal Inputs

Supported Modes:

Sensor	Supported types
Milliamps	0 to 20 and 4 to 20
Voltage	0 to 2.0 VDC
Millivolt	+/-250, +/-100, and 0 to 250
Ohms	0 to 30K and 0 to 300K
Thermo Couple	J, K, T, E, R, S, B, and N types
RTD 10	3 wire , and 2 wire
RTD 100-385	3 wire and 2 wire
RTD 100-392	3 wire and 2 wire
RTD 1K	3 wire and 2 wire
Thermistor	10K type II and type III

Scaling: integer, to engineering units, with configurable decimal point
 Forcing: to scaled value, or none
 Signal Conditioning: "Boxcar" Averaging, 1 to 32 samples
 Measurements: Totalization with configurable sampling interval
 Communications: Individually settable to trigger message transmission on level change

Analog Outputs

Mode: 20mA (0 to 20mA or 4 to 20mA), voltage with external resistor
 Scaling: integer, to engineering units, with configurable decimal point
 Forcing: to scaled value, or none
 Comm Fail States: Preset value or HOLD (individually settable by channel)

Digital Inputs

The Ascent Digital Inputs support signals from DC sensors with output levels from about 8Vdc up to 30Vdc. The Digital Inputs have software configurable inversion, forcing, filtering, runtime accumulation, rate measurement and high-speed totalizers. Rate and totalizer values are scalable to engineering units. Changes on individual digital inputs can be configured to "wake up" the Ascent module and send off a message in Master or Mirror mode.

Forcing

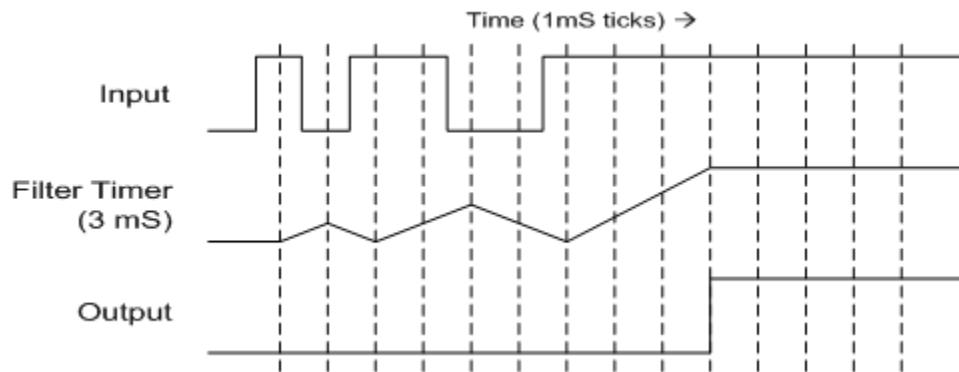
The Ascent Digital Inputs can be "forced" ON or "OFF" to support system troubleshooting and to temporarily bypass defective sensors. Forcing causes the Ascent module to ignore the "real" input state. Forcing is non-volatile and can be set individually for each input channel via the configuration web interface or via communications registers. When forced, the CPU Status light will blink slow red.

Invert

The Ascent Digital Inputs accept contacts closures and low-voltage DC input signals. A closed contact to ground, or a low input level are registered as an "ON". An open contact or voltage above a couple of volts is registered as an "OFF". Digital Inputs can be configured individually to invert this operation as required via the configuration web interface or via communications registers.

Filtering/Delay

The Ascent Digital Inputs can be individually configured to filter incoming noise and contact bounce or delay an input signal, in 1mS increments, from 0 to 65,535mS (65 seconds). To register an "ON", the input must be ON more than it is OFF by the set filter time. The filter/delay time can be set via the configuration web interface or via communications registers.



DI Stretch

Ascent I/O modules support “stretching” the ON time of Digital Inputs so that there is less chance of an input being “missed” over a slow communications network. For example, the press of a pushbutton being read over a slower polled leased line network could easily be missed unless the operator holds the button in for a period of time that exceeds the time between polls. If a PLC reads the stretched DI bit for that input, the operator doesn’t need to hold the button in; the Ascent module does it for him. Stretching only affects the state of a special set of bits that can be read by communications. No other functions including the “normal” digital input bits are affected. The stretching time is configurable in 100mS increments.

Runtime

Ascent I/O modules keep track of the ON time (runtime) of each Digital Input in 32-bit non-volatile registers that can be accessed by communications or viewed via the web HMI. Internally, runtime is recorded and kept in seconds, but can be displayed as seconds, minutes (to tenths of a minute) or hours (to tenths of an hour) on HMI web pages and displays. The display units are individually configurable for the accumulated runtime on each input channel as follows:

```
##### Seconds
#####.# Minutes
#####.# Hours
```

Totalization

Ascent I/O modules totalize OFF to ON transitions of their Digital Inputs into 32-bit non-volatile registers that can be accessed by communications or viewed via the web HMI. Each totalizer also has a scaled display register that can also be accessed by communications or viewed on HMI web pages and displays. Scaling is configurable with an integer divisor and a decimal point format as follows:

Scaled value = 32-bit Totalizer/Divisor

In the following examples, the Ascent I/O module counts pulses from a flow meter. Every pulse represents a certain number of gallons of flow, so that by counting the pulses, the total flow can be recorded and displayed.

Example #1: DIGITAL PULSE FLOW METER Every pulse = 100 gallons

Divisor: 100

Format: #####.#

Every pulse in from a flow meter represents 100 gallons of flow, so every 10 counts equals 1000 gallons. The Ascent I/O module is configured to divide the total by 100 so that the HMI display will show 1000s of gallons with a resolution of 100 gallons (#####.# Kgal)

OK, well that was easy. But what if each pulse represents an odd number, like 17 gallons per pulse?

Example #2: DIGITAL PULSE FLOW METER Every pulse = 17 gallons

Divisor: 170

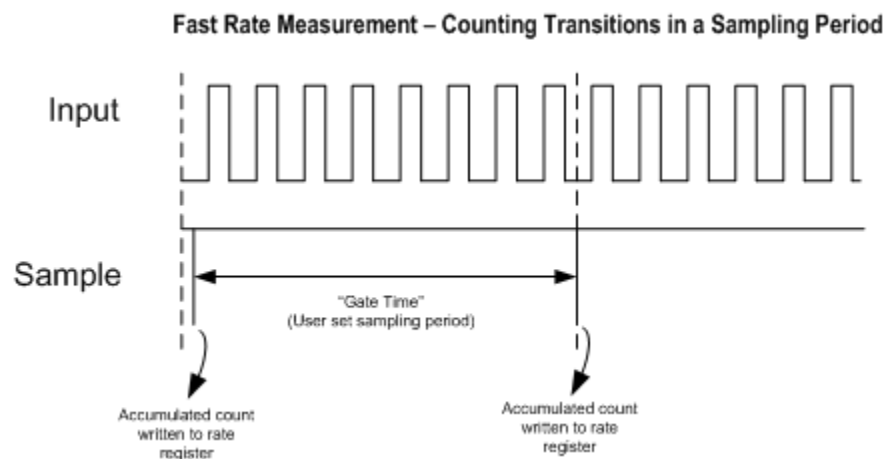
Format: #####.##

Every pulse in from a flow meter represents 17 gallons of flow, so every 100 counts equals 1700 gallons. The Ascent I/O module is configured to divide the total by 170 so that the HMI display will show 1000s of gallons with a resolution of 100 gallons (#####.## Kgal)

Rate

Ascent I/O modules continuously measure the transition rate of each Digital Input. The measurement technique can be selected for each input channel to optimize the update speed and measurement resolution. The calculated rate, as well as the “raw” counts and intervals can be accessed by communications. The calculated rate can be displayed on HMI web pages and displays, scaled to engineering units.

For higher pulse rates (greater than 100 pulses /second), the pulses are totalized over a configurable time period (“gate time”). In this mode, the reading is updated at the same rate as the gate time.



When a new sample is recorded at the end of the gate time, the Ascent I/O module will also scale the latest reading so that it can be easily displayed on HMI web pages and displays. Scaling is configurable with an integer numerator and divisor, and a decimal point format as follows:

Scaled value = (Rate Count x Numerator)/Divisor

Note that this scaling technique applies only to high-speed rate measurements. If Slow Rate Mode is selected, the scaling is slightly different as described further on.

In the following example, the Ascent I/O module counts pulses from a flow meter. Every pulse represents 1.2 gallons of flow and the flow can reach up to 1000 gallons per minute. By counting the pulses over a one minute sampling period (“gate time”), the flow rate can be calculated.

Example #1: FAST FLOW METER Every pulse = 1.2 gallons and sample time is 60 seconds

Rate Mode: Normal (fast)

Gate Time: 60 seconds

Numerator: 12

Divisor: 1

Format: ####.##

Every pulse in from a flow meter represents 1.2 gallons of flow, so every 10 counts that we record within the 1 minute sampling period equals 12 gallons. The Ascent I/O module is configured to first multiply the sampled count by 12 (numerator) and then divide the result by 1 (divisor) so that the HMI display will show gallons per minute (GPM) with a resolution to tenths of gallons (#####.## GPM)

OK, well that was easy because we want to read out in gallons per minute and our sampling time is one minute. What if we want to see our reading get updated twice as fast using a faster gate time?

Ascent Combo I/O Module

Example #2: FAST FLOW METER Every pulse = 1.2 gallons and sample time is 30 seconds

Rate Mode: Normal (fast)

Gate Time: 30 seconds

Numerator: 24

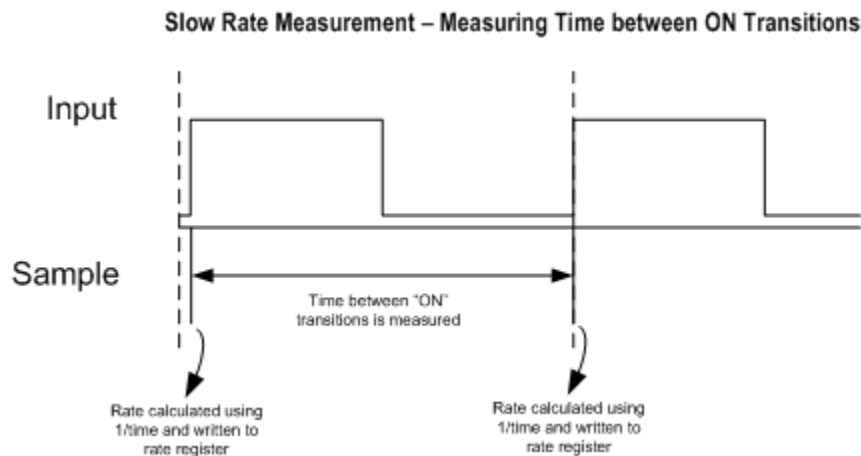
Divisor: 1

Format: #####.#

Every pulse in from a flow meter represents 1.2 gallons of flow, so every 10 counts that we record within the 30 second sampling period equals 12 gallons. Since the sampling period is now half of a minute, the Ascent I/O module is configured to first multiply the sampled count by 24 (numerator) and then divide the result by 1 (divisor) so that the HMI display will show gallons per minute (GPM) with a resolution to tenths of gallons (#####.# GPM). Note that we doubled the numerator to compensate for halving the sampling time. Because we're using a faster sampling period, the reading will update faster, but we'll be working with fewer sampling counts, so the reading may jump around a little more and be a little bit less accurate.

For input channels that will monitor slower pulse rate signals, the Ascent I/O module can be configured to use a "Slow Rate Mode". For example, a municipal water meter may give us a pulse for every 100 gallons of flow. For a small system, we may only get 6 or 7 pulses every minute, representing 600 to 700 gallons of flow. To get any kind of useful reading resolution using the sampling period technique, we would have to set the sampling period to a very long time, like an hour or a half hour. That means that the flow rate reading would update very slowly also. To solve this problem, the Ascent I/O module has a "Slow Rate Mode". In this mode, the module measures the time interval (in milliseconds) between OFF to ON transitions, and then calculates the rate using the relationship of:

$$\text{Rate} = 1/\text{Time}(\text{mS})$$



Using this technique, the reading is updated on each OFF to ON transition of the input signal. So using the example above, if the module received a pulse 6 times per minute, then the readings would be updated on every transition, or once every 10 seconds. In addition, the resolution of the readings will be much higher with this technique, so that if the "real" rate is 6.5 pulses per minute, the calculated rate will not jump between 600 and 700 GPM, but read "in between" or 650 GPM.

When a new sample is recorded on each positive transition, the Ascent I/O module will also scale the latest reading so that it can be easily displayed on HMI web pages and displays. Scaling is configurable with an integer numerator and divisor, and a decimal point format as follows:

$$\text{Scaled value} = (\text{Numerator}/\text{Time}(\text{mS})) * \text{Multiplier}$$

Note that this scaling technique applies only to "Slow Rate Mode" measurements. If the normal Fast Rate Mode is selected, the scaling is slightly different as described above.

In the following example, the Ascent I/O module counts pulses from a municipal flow meter. Every pulse represents 100 gallons of flow and the flow can reach up to 1000 gallons per minute. By counting the time between pulses, the flow rate can be calculated with very good accuracy and updates rates.

Example #1: SLOW FLOW METER Every pulse = 100 gallons Max. flow rate is 1000 GPM (10 pulses per minute)

Rate Mode: Slow
 Numerator: 10000
 Multiplier: 10
 Format: ####

Every pulse in from a flow meter represents 100 gallons of flow. At 1000 gallons per minute, the period between pulse will be 100mS (1/10 of a second). We don't expect any smaller time period because 1000 GPM is the absolute maximum flow. If our numerator is set to 1000 (try to use larger numbers for better accuracy, but not exceeding 65,535), then at the maximum flow rate of 1000 GPM, the numerator of 10000 divided by the time period in milliseconds (100) will equal 100. When we multiply that by 10 ("multiplier"), we get a readout of 1000 GPM resolving to 1 GPM.

$$10000/100(\text{mS}) = 100 \times 10 = 1000 \text{ GPM}$$

If the flow rate is slower than that, say 6.5 pulses per minute, the time period between ON transitions is longer (154 mS), and our readings change according:

$$10000/154(\text{mS}) = 65 \times 10 = 650 \text{ GPM}$$

OK, so how do I choose the numerator and multiplier? Basically, because we are using 16-bit integer math, for best accuracy, try to use the largest numerator possible, then get the number to come out right with the multiplier. For example, the above scenario would be better using twice the numerator and half the multiplier, but it's harder to explain than the first example.

Example #2: SLOW FLOW METER Every pulse = 100 gallons Max flow rate is 1000 GPM (10 pulses per minute)

Rate Mode: Slow
 Numerator: 20000
 Multiplier: 5
 Format: ####

Using the above example of 6.6 pulses per minute:

$$20000/154(\text{mS}) = 130 \times 5 = 650 \text{ GPM}$$

Each one millisecond will represent 5GPM instead of 10 GPM, giving twice the resolution.

Digital Outputs

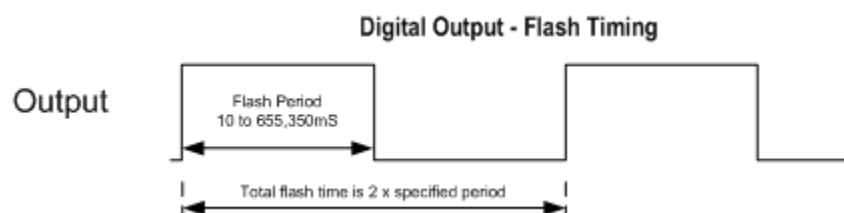
Forcing

The Ascent Digital Outputs can be "forced" ON or "OFF" to support system troubleshooting and to temporarily operate control devices. Forcing causes the Ascent module to leave an output in a certain state and ignore commands to change the output state. Forcing is non-volatile and each output can be set individually via the configuration web interface or via communications registers.

Flashing

The Ascent Digital Outputs can be "flashed" at a configurable rate specified in milliseconds. Flashing is synchronized between all outputs channels. This function is generally used to operate visual or audible alarm annunciators.

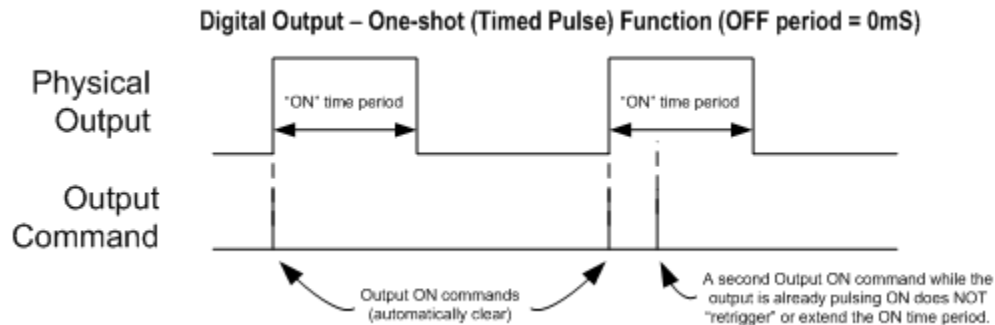
The flashing period is settable in 10mS increments from 10mS to 655,350mS (655 seconds). The flash time is the ON or OFF time (half the total cycle time), so that the total flash period (ON + OFF time) is twice the time specified (50% duty cycle).



Output Timing Functions

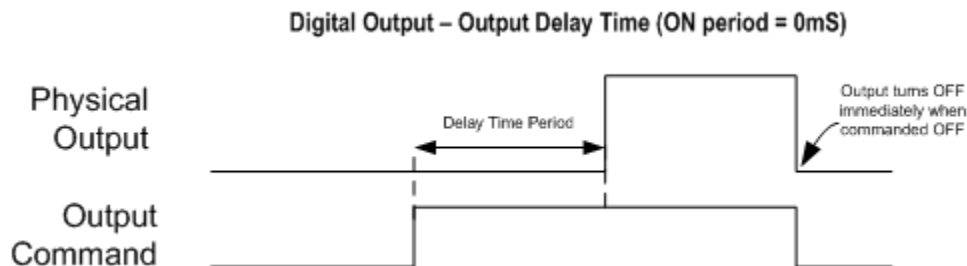
The Ascent Digital Outputs can be, delayed, pulsed or used to generate a frequency with configurable ON and OFF times. Output time periods are individually settable for each input channel, from 0 to 655,350 milliseconds (655 seconds) in 10 millisecond increments. All output timing functions for a given channel are disabled if both the ON and OFF times are set to zero.

If only the ON time has a non-zero value, the output will be pulsed ON for the specified time period, and then turned OFF (one-shot) each time the channel is commanded “ON”. It is not necessary to command the channel OFF again before re-firing the output. If a second output ON command is received while the output is already ON, the output time will be “retriggered”.



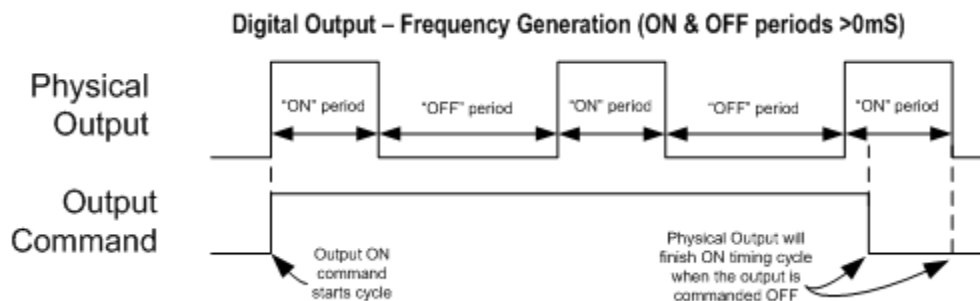
A typical application is control of motorized actuators and dampers to move an approximate distance based upon actuation time.

If only the OFF time has a non-zero value, the output will be delayed for the specified time period, and then turned ON until it is commanded OFF.



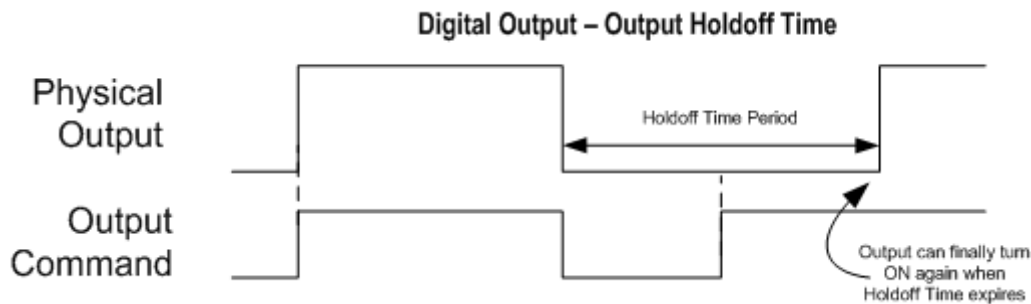
A typical application is duplex pump control, where by setting the delay times differently between two pump call outputs, the pumps will not turn ON simultaneously, avoiding high peak power demands and stressing pipes with pressure surges.

If both the ON and the OFF times are set to non-zero values, the output will continually cycle ON and OFF for the specified times as long as the output is commanded “ON”. This mode is frequently used with heaters, metering pumps and other devices that are controlled by varying their ON to OFF time duty cycle ratio.



Output Holdoff (Rapid Cycling Protection)

The Ascent Digital Outputs can be protected against rapid cycling of the individual outputs that could damage certain devices such as high horsepower motors and pumps. There is no delay time if the outputs have been OFF for the specified amount of holdoff time. This feature can also enforce a well “recharge” time. If an outputs holdoff value is set to a non-zero value, the output will be held OFF for the specified amount of time from when it was turned OFF even if it is commanded to turn ON again. This feature will also prevent an output from prematurely turning ON after recovery from a power failure (Holdoff Timers restart on power ON). The Output Holdoff time may be set from 0 to 65535 seconds in 1 second increments.



Communications Failure Output States

The Ascent Digital Outputs can be individually set to predetermined states when a communications failure occurs, providing a degree of failsafe protection. Each individual Digital Output can be set to hold its last state, turn OFF or turn ON. Communications failure detection can be enabled individually on each port. When communications is restored, the outputs will remain unchanged until written to by the Host system (they are not automatically restored to their pre-failure condition).

A typical application might turn a set of well pump outputs OFF when communications from a tank (tank level used to control the pumps) fails, in order to avoid overfilling the tank.

Ascent Combo I/O Module

Universal Inputs

Input Modes

The input mode on an Ascent is entered by the web page interface. The mode numbers for each channel are independent for all two wire and three wire sensors. To use a three wire sensor, two adjacent channels are necessary in these combinations: 1 and 2, 3 and 4, 5 and 6, 7 and 8. Therefore the Ascent Combo can have up to four three wire RTD sensors.

Sensor	Mode Number	Range (or Degrees C x 10)	Degrees F x 10
Milliamps 0 to 20	0	0 to 20000	
Milliamps 4 to 20	1	4000 to 20000	
Voltage 0 to 2.0 VDC	2	0 to 20000	
Millivolt +/-250	3	-25000 to 25000	
Millivolt +/-100	4	-10000 to 10000	
Millivolt 0 to 250	5	0 to 25000	
Ohms 0 to 30K	6	0 to 30000	
Ohms 0 to 300K	7	0 to 30000	
Thermo Couple J	8	-2072 to 12029	-3409 to 21972
Thermo Couple K	9	-2160 to 13754	-3568 to 25077
Thermo Couple T	10	-2130 to 4033	-3514 to 7579
Thermo Couple E	11	-2071 to 10009	-3407 to 18336
Thermo Couple R	12	-933 to 17930	-1359 to 32594
Thermo Couple S	13	-858 to 17825	-1224 to 32405
Thermo Couple B	14	2455 to 18393	4739 to 33427
Thermo Couple N	15	-2240 to 13035	-3712 to 23783
RTD 10 3 wire	16	-3200 to 5000	-5440 to 9320
RTD 10 2 wire	17	-3200 to 5000	-5440 to 9320
RTD 100-385 3 wire	18	-2469 to 8894	-4124 to 16329
RTD 100-385 2 wire	19	-2469 to 8894	-4124 to 16329
RTD 100-392 3 wire	20	-2427 to 8700	-4048 to 15980
RTD 100-392 2 wire	21	-2427 to 8700	-4048 to 15980
RTD 1K 3 wire	22	-2469 to 8894	-4124 to 16329
RTD 1K 2 wire	23	-2469 to 8894	-4124 to 16329
Thermistor 10K type II	24	-587 to 2286	-736 to 4434
Thermistor 10K type III	25	-659 to 2485	-866 to 4793
Pulse Rate Input	100	0 to 20000	

Forcing

The level of individual Analog Inputs in Ascent I/O modules can be “forced to support system troubleshooting and to temporarily bypass defective sensors. Forcing causes the Ascent module to ignore the “real” input reading. Forcing is non-volatile and can be set individually for each Analog Input channel via the configuration web interface or via communications registers.

Scaling

To provide meaningful information on HMI web pages and displays, the Analog Input values may be scaled to engineering units. Both the unscaled and scaled values can be accessed by communications.

Analog Input scaling is configurable with an integer numerator, divisor, offset and a decimal point format as follows:

$$\text{Scaled value} = ((\text{Analog Input uA} * \text{Numerator}) / \text{Divisor}) + \text{Offset}$$

All values are 16-bit integers. Note that the Offset can be a signed number (+/- 32,767). The other scaling values are unsigned.

In the following example, the Ascent I/O module receives a 4 to 20mA signal from a flow meter that has a 0 to 1000 GPM range.

Example #1: 4-20mA FLOW METER 4mA = 0GPM, 20mA = 1000 GPM

AI Mode: 4 to 20mA (raw readings of 0 to 16,000)

Numerator: 1000

Divisor: 16000

Offset: 0

Format: #####

For most applications, the Divisor will be set to the input reading at 20mA (16,000 or 20,000 depending on the Mode) and the Numerator will be set to the corresponding engineering unit value at 20mA. In this example, the Analog input mode is set to 4 to 20mA, so the Divisor is set to 16,000 and the Numerator is set to 1,000 (GPM). The Offset will probably be zero since most 4 to 20mA flow meters represent zero flow as 4mA without an offset. So for a 20mA signal input, the Ascent module performs the following scaling calculation:

$$(([20\text{mA reading}] * 1000) / 16000) + 0 = 1000 \text{ (GPM)}$$
$$((16000 * 1000) / 16000) + 0 = 1000 \text{ (GPM)}$$

OK, so how about a tank level where the level of the sensors is mostly likely several feet up on the tank? That means that we need to offset the scaled reading by the sensor elevation above the tank bottom.

Example #2: TANK LEVEL SENSOR 4mA = 0ft., 20mA = 30ft. Sensor is 3.5ft. above the bottom of the tank.

AI Mode: 4 to 20mA (raw readings of 0 to 16,000)

Numerator: 300 (30.0 with an imaginary decimal point)

Divisor: 16000

Offset: 35 (3.5 with an imaginary decimal point)

Format: #####.

Again, we set the Divisor to the input reading at 20mA (16,000 in 4 to 20mA Mode) and the Numerator will be set to the corresponding engineering unit value at 20mA, or 300 to represent 30.0 with an imaginary decimal point. In this situation, we need to add 3.5 feet to the readings, because the sensor is 3.5ft. above the bottom of the tank, so the Offset is set to 35 to represent 3.5 with an imaginary decimal point. So for a 20mA signal input, the Ascent module performs the following scaling calculation:

$$(([20\text{mA reading}] * 300) / 16000) + 35 = 335$$
$$((16000 * 300) / 16000) + 35 = 335$$

With the formatting set to #####., the level will be displayed as 33.5 (feet)

Totalization

Ascent I/O modules totalize readings from their Analog Inputs into 32-bit non-volatile registers that can be accessed by communications or viewed via the web HMI. The scaled value of each Analog Input is added into their respective totalization registers every AI Gate Time Period (a configurable value in 1 second increments).

Ascent Combo I/O Module

Universal Inputs to Analog Output Scaling

Universal Inputs may be applied to Analog Outputs and scaled to usable ranges of 0 to 20mA or 4 to 20mA scaling. This can be done from an Ascent to a Sprite, an Ascent to an Ascent over telemetry or from the inputs of an Ascent to its own outputs using the Link Local UI to AO configuration.

The tables below show the conversion ranges that happen automatically across a link to give a useable current output scaling.

All decimals are implied for clarity. All values are 16 bit integers.

4mA or 0mA mode is selected via the Analog Output Mode representing the sensor.

IO Type	+/-100mV	+/-250mV	0-250mV	30KOhm	300KOhm	4-20mA	0-20mA
20mA	100.00	250.00	250.00	30.000	300.00	20.000	20.000
4/0mA	-100.00	-250.00	0	0	0	4.000	0

TC -X = ThermoCouple devices:

IO Type	TC-J	TC-K	TC-T	TC-E	TC-R	TC-S	TC-B	TC-N
20mA	1200.0	1400.0	400.0	1000.0	1800.0	1800.0	1800.0	1300.0
4/0mA	-200.0	-200.0	-200.0	-200.0	-100.0	-100.0	200.0	-200.0

RTD - xxx = Resistive Thermal Device

TH - xxx = Thermistor

RTD - xx - 3WR = RTD resistance on the second channel of a 3 Wire RTD device

IO Type	RTD-385	RTD-392	RTD-427	Th-II	Th-III	RTD-10-3WR	RTD-100-3WR	RTD 1000 3WR
20mA	800.0	800.0	300.0	200.0	200.0	20.00	400.00	4000.0
4/0mA	-200.0	-200.0	-200.0	-40.0	-40.0	1.00	100.0	1000

Analog Outputs

Forcing

The level of individual Analog Outputs in Ascent I/O modules can be “forced to support system troubleshooting and to temporarily operate analog control devices. Forcing causes the Ascent module to ignore the “real” output value sent via communications. Forcing is non-volatile and can be set individually for each Analog Output channel via the configuration web interface or via communications registers.

Totalization

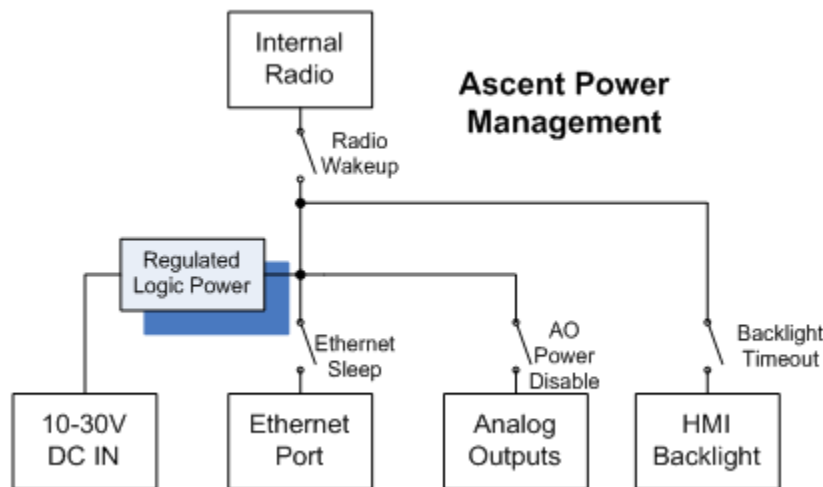
Ascent I/O modules totalize readings from their Analog Inputs into 32-bit non-volatile registers that can be accessed by communications or viewed via the web HMI. The scaled value of each Analog Input is added into their respective totalization registers every AI Gate Time Period (a configurable value in 1 second increments). Additional scaling on the totalized value is supported in order to adjust the displayed totalizer values (usually by some factor of 10) to make values shown on the web HMI a little more user friendly. For example, the totalizer may resolve down to gallons, but the reading may be displayed in KGALS (thousands of gallons) or MGAL (millions of gallons).

Communications Failure Output Levels

The Ascent Analog Outputs can be individually set to predetermined levels when a communications failure occurs, providing a degree of failsafe protection. Each individual Analog Output can be set to hold its last level, to be set to a preset level.

Power Management

The Ascent I/O module provides a number of special features to control and reduce power consumption. Refer to the figure below for an overview of the power management features:



AO Power Disable

If selected, the 24v power to the Analog Output Section is disabled. This can save considerable amounts of power if the Analog Outputs are not being used.

Ethernet Sleep

If selected, the Ethernet section is automatically powered down if there is no active Ethernet connection to the Ascent I/O module within the first few seconds of being powered ON.

Internal Radio Wakeup

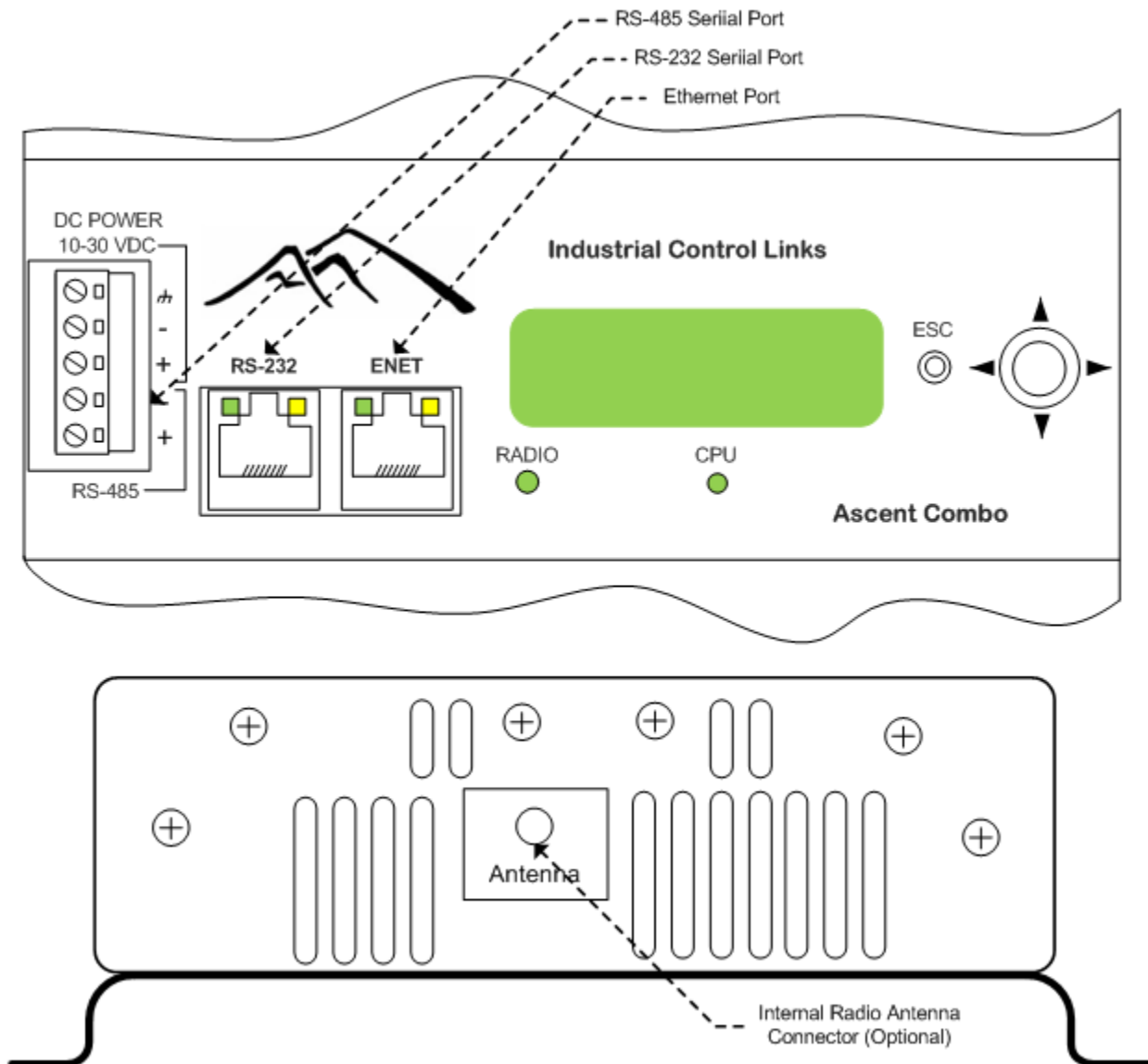
If a radio wakeup time is specified (for the internal radio option), the radio will be powered down until it is actually needed to send a message. Used with “send on change” or slow polling Master Mode operation can significantly reduce power consumption.

HMI Backlight

If selected, the backlight to the HMI will be shut off after this period of inactivity on the HMI interface buttons. Any key press will turn it back on.

Communications Operation

Ascent Combo Input/Output (I/O) modules come with a high-speed Ethernet port with a RS-232/RS-485 serial port as well as an optional internal spread spectrum radio. All three communications ports operate independently.



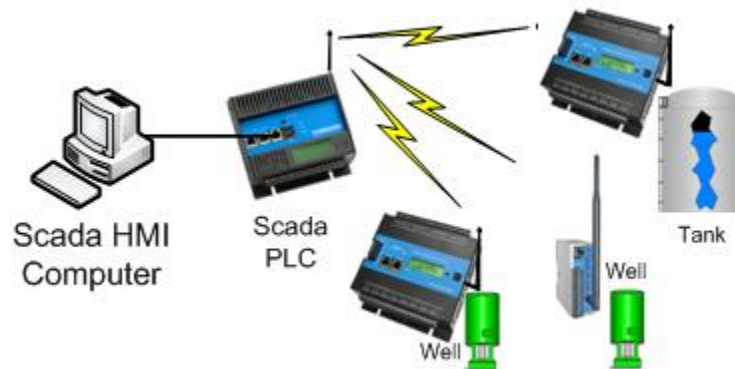
Unless specifically disabled, all communications ports operate as “slaves” (servers)—listening and responding to requests from external “Masters” (clients). In addition, any single port can be designated as a “Master” that can initiate messages based on a timed interval and/or a change of state on a digital input or a level change on an analog input.

The Ethernet port supports HTTP protocol for serving configuration and user web pages and Modbus and SDX (Secure Data Exchange) for “register” data access. The optional serial and radio ports support Modbus RTU, DF1, Bricknet and SDX protocols. SDX is the preferred “over-the-link” protocol for either Ethernet or serial links since it is secure (AES-128 encryption) and can transfer multiple data types in a single packet for maximum efficiency. Modbus and DF1 provide easy connectivity to many third-party PLCs and HMI software and devices, while Bricknet provides backwards compatibility with older ICL devices. All of these protocols can coexist and operate simultaneously over the same port except for DF1 whose design is not compatible with simultaneous Modbus operation.

Ascent I/O modules can also be used as stand-alone pump or setpoint controllers, as peer-to-peer I/O that interconnects the Analog and Digital Inputs and Outputs of two or more locations, and as RTUs for distributed I/O as part of a larger SCADA system with a host PLC or Master RTU.

Distributed I/O

Ascent I/O modules can expand the I/O capacity of a PLC system, or serve as remote distributed I/O as part of a SCADA system. Most HMI software packages such as InTouch (Wonderware), FIX (GE/Intellution), VTScada (Trihedral) and most major PLCs can communicate with Ascent I/O modules via Modbus or DF1 communications. When used with ICL programmable SCADA Controllers, Ascent I/O modules support the ultra-secure AES-128 encrypted SDX protocol with the additional benefits of true store-and-forward message routing, transmit on exception and the ability to send all information, analog and digital, inputs and outputs, in a single message for better response and to minimize radio traffic.



Besides providing basic sensor input and control output functions in a SCADA system, Ascent I/O modules provide filtering and averaging of both analog and digital signals, measure and totalize flow from both analog and digital sensors, and keep track of runtime, offloading these tasks from the central host. This is especially important when the SCADA system utilizes slower SCADA communications links such as leased-line modems and licensed radios.

Ascent modules are fully compatible with the Sprite and Solaras modules available from ICL as shown above.

Peer-to-Peer I/O

Two or more Ascent I/O modules can be configured to communicate “back-to-back”, passing Analog and Digital Input and Output signals between locations. This is known as peer-to-peer or “mirrored” I/O. Ascent I/O modules can also be mirrored with Solaras and Ascent I/O for lower power and larger I/O configurations.

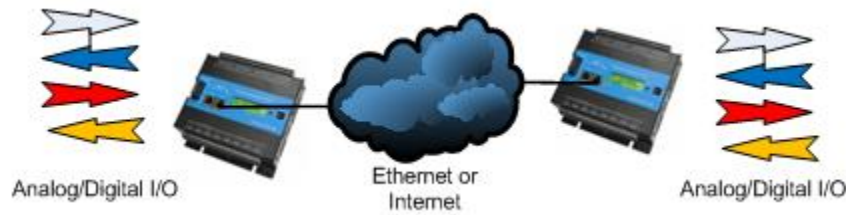
Peer-to-Peer I/O can operate through any port; Ethernet, serial or internal radio, but only one at a time. All ports are still active as slaves (servers) while any single port is being used for peer-to-peer I/O. This allows HMI terminals and software, PLCs, etc. to communicate with the Ascent modules while they are actively exchanging I/O information. The built-in user and configuration web pages and optional remote Viewpoint Express Remote HMI panel can be used simultaneously with peer-to-peer I/O operation.

In the simplest form of a peer-to-peer I/O system, there is one “Master” and one “Slave” module. All of the configuration of the system is done via web pages on the Master Module. When the Master links up with the Slave, it automatically configures the slave and then begins I/O exchange operation. If both Ascent modules are accessible via the Ethernet (or Internet) connection, a PC can access the User web pages on either unit.



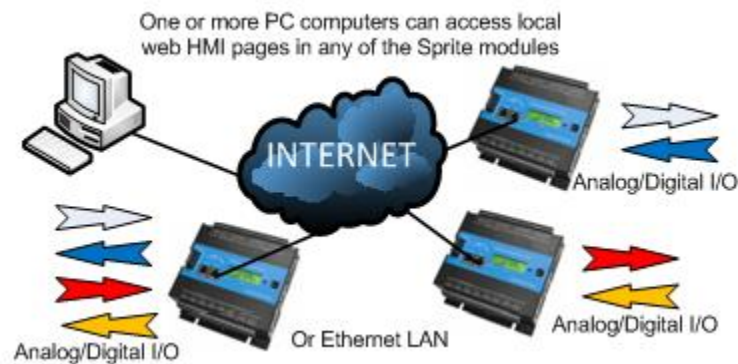
Ascent Combo I/O Module

In a strictly point-to-point serial or wireless system, the local web pages can be accessed using a PC computer plugged into one unit, which can be used to view the data for both sides of the peer-to-peer link.



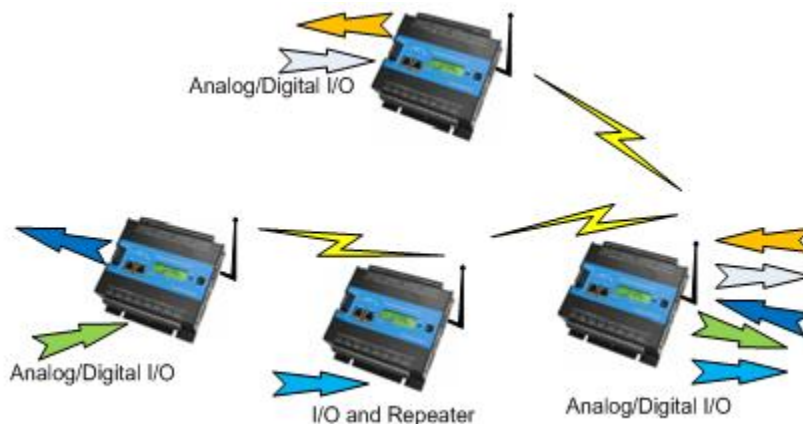
Note that a PC is not required to make these systems work, other than for possible configuration changes, but the User web pages provide a very easy to set up user interface.

Although the most basic configuration is two Ascent modules “talking” back-to-back, systems with more than two modules can be used to share I/O among more locations.



When more than two Ascent I/O modules are used, typically portions of the I/O available in each remote module is brought back to a single central module. For example, in the case above, the I/O going in and out of the left-hand Ascent I/O module is divided between two Ascent modules on the right-hand side. In larger configurations, the central module might be an Ascent Combo I/O module which has several times more I/O than the Ascent modules, and is compatible with them.

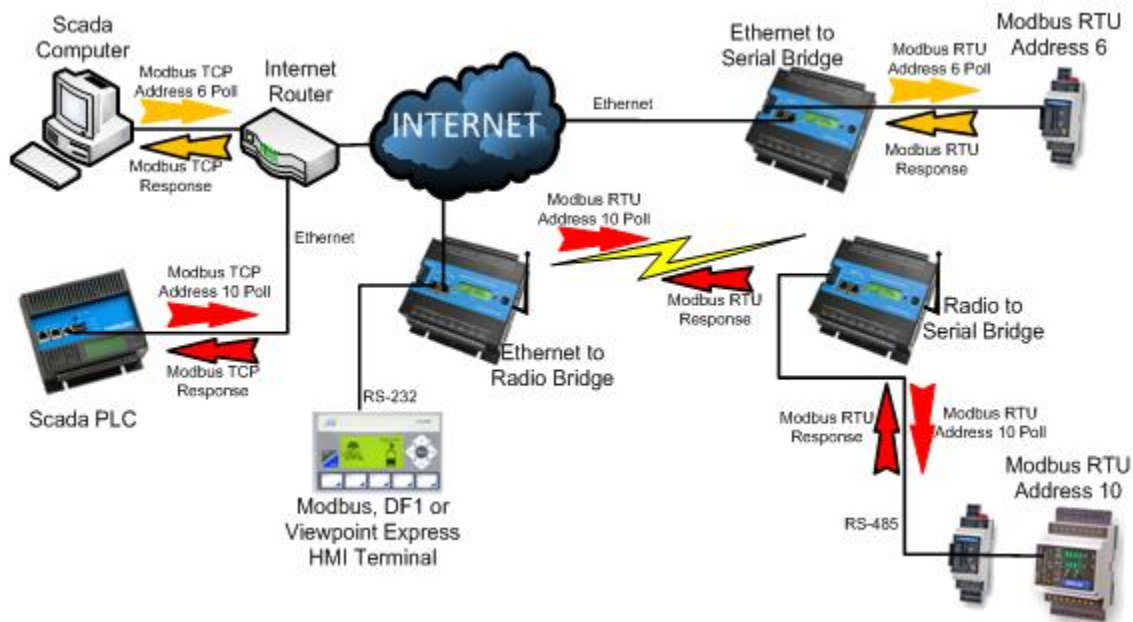
In addition to combining I/O from multiple locations, Ascent I/O modules have built-in Store-and-Forward capabilities, so that any Ascent module can act as a repeater in a wireless system.



Bridging

Ascent modules, having both a serial and Ethernet interface have the ability to pass data from Ethernet to serial interfaces and back again. They also have a serial to radio bridging mechanism that essentially ties the radio network to the serial network and treats them as if all of the units can talk to each other. This assumes that the protocol used is half duplex. This operation is known as bridging. The following example shows Ethernet to

Serial bridging, Radio to Serial and Ethernet to Radio bridging using Modbus TCP to RTU and back again protocol translation.



There are two examples in the diagram of the Bridging functionality. In the first example, the Scada Computer polls for unit address 6 over Modbus TCP to the Ethernet to Serial Bridge Over Modbus TCP, the Scada Computer must know the IP address of the Ethernet Bridge and be able to modify the Modbus address (unit ID) within the Modbus TCP message to 6 in this case. This poll message is represented by the yellow arrow. When the Ethernet to Serial Bridge Ascent receives this message, it looks at the unit ID (Modbus Address) and sees that it is not for it. It then converts the Modbus TCP message to Modbus RTU and puts it out on the serial network. In this case to a Picobrick addressed as 6. The Picobrick receives the message and acknowledges it with a response. The Ethernet to Serial Bridge Ascent hears that message and converts it back to the appropriate Modbus TCP response and sends the response back to the Scada Computer. This message is represented by the yellow arrow.

In the second example, a Scada PLC (in this case an ICL Pinnacle Series Lassen controller) is talking with Address 10. It poll using a Modbus TCP message to the Ethernet to Radio Bridge in the middle. The Ethernet To Radio Bridge sees that the message is not addressed to it by the Unit ID of the Modbus message and forwards it on to the radio link. The Radio to Serial Bridge unit sees that the message is not for it either and forwards the message out to the serial RS-485 port where Modbus Address 10 and can receive it (in this case an ICL Microbrick). This message is represented by the red arrow. Address 10 then responds to the poll message and the reverse route is take back though the Radio to Serial Bridge and up to the Ethernet to Radio Bridge back to the Scada PLC. This message is represented by the red arrow.

Installation

Mechanical Installation

Ascent I/O are designed to be installed in a protective enclosure with the appropriate NEMA rating for the environment that the controller will be used. Typical NEMA ratings are as follows:

North America:

Indoor applications only: NEMA 1 Indoor or Outdoor applications: NEMA 4, 4X or 12 rated enclosures.

European Union:

Must be installed inside IP54 or IP56 rated enclosures.

Transient suppression must be supplied externally for each active signal for the following circuits:

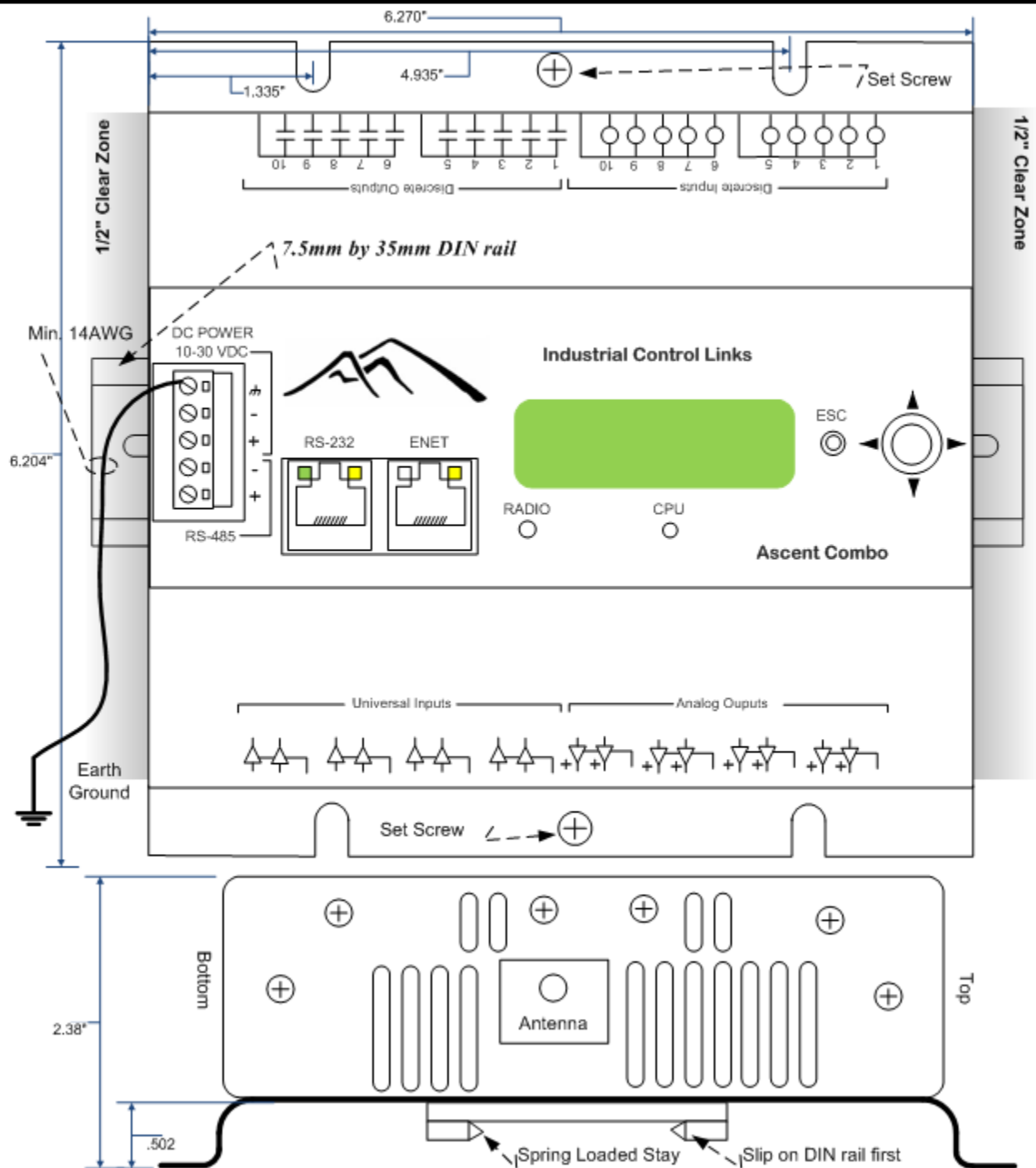
<i>Signal(s)</i>	<i>Maximum Operating Voltage</i>	<i>140% Transient Suppression Level.</i>	<i>Circuit Connection</i>
Optically Isolated Digital Inputs 120 VAC RMS/DC	300V	420VAC RMS or 420VDC	DI to DI Common
RS 232 Signals (DTR, CD, RTS, CTS, RX, and TX) *	+/- 12VDC	+/- 16.8VDC	Signal to RS 232 Common

**** Different RS-232 ports support different signal configurations. Some signals may not be available on some ports and therefore do not need transient protection. Refer to the RS-232 pin out table later in this document for details.***

The enclosure material must be a minimum of 1.14mm (0.045”) thick. Typically, the controller is mounted vertically in such an enclosure on a steel DIN rail. If an alternative mounting scheme is used, it is recommended that the controller be mounted on a noncombustible surface.

External surge suppression must be installed to limit all operating voltages to within 140% of signal voltage. This includes all RS-232 signals, Digital Input terminals.

CAUTION: If the controller is mounted on or above a combustible surface (such as a wood backboard), a plate of at least 1.43mm (0.056”) galvanized or 1.6mm (0.063”) uncoated steel extending at least 150mm (5.9”) beyond the controller on all sides must be installed.



Two snap on DIN rail mountings are located on the back of the unit. Simply slide the top side of the mountings onto the DIN rail and press down to snap the bottom into place. The spring loaded stays allow the unit to be removed by lifting up and pulling the top "hooked" part of the mountings off of the DIN rail and lowering the unit until the spring loaded stays come free.

Two #10 set screws are supplied to keep the unit from "rocking" on the DIN rail after mounting. The set screws are NOT a source of earth grounding.

Electrical Installation

All field wiring connections to and from the Ascent RTU, except for RS-232 and Ethernet communications are made via removable terminal blocks.

Ascent Combo I/O Module

Class 1 Division 2 Group A, B, C, and D Requirements

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.

WARNING - EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;

AVERTISSEMENT - RISQUE D'EXPLOSION – LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMBLEMENTS DE CLASSE I, DIVISION 2;

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS;

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DÉCONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

WARNING - DO NOT REMOVE OR REPLACE ANY CONNECTORS OR FUSES OR OPERATE DIP SWITCHES WHILE CIRCUITS ARE LIVE UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS OF FLAMMABLE GASSES OR VAPORS.

AVERTISSEMENT - RISQUE D'EXPLOSION - COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX AVANT DE REPLACER LE COMPOSANTS

Battery type: Lithium Coin Battery, Renata CR2032

NOTE: The terminal block screws must be tightened to 7 lb-in.

Diagrams in the following sections provide examples for analog and discrete I/O and power wiring. The following wiring guidelines must be followed:

Stranded conductors from #14 to #26 AWG, or solid conductors from #12 to #26AWG consisting of either copper or copper-clad aluminum is permitted.

Wires must be rated for 240V, 90°C and suitably current rated.

Wire insulation must be a minimum of 0.9mm (0.031") thick if subjected to movement, flexing or handling during use or maintenance.

Wires shall be routed away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and the like.

Clamps and guides, if used, shall be provided with smooth, well-rounded edges.

Wiring that is subject to flexing during servicing such as that from a stationary part to a part mounted on a hinged door shall be provided with additional insulation at any point where flexed.

Additional insulation, if used, shall be insulating tubing, or a wrapping of not less than two layers of insulating tape. All must be minimum of 90°C and 240V.

All splices and connections must be mechanically secure and provide electrical continuity

Conductors are also not to be grouped.

CAUTION: Use supply wires suitable for 15°C above surrounding ambient

ATTENTION: Utiliser des fils d'alimentation qui conviennent a une temperature de 15°C au-dessus de la temperature ambiante.

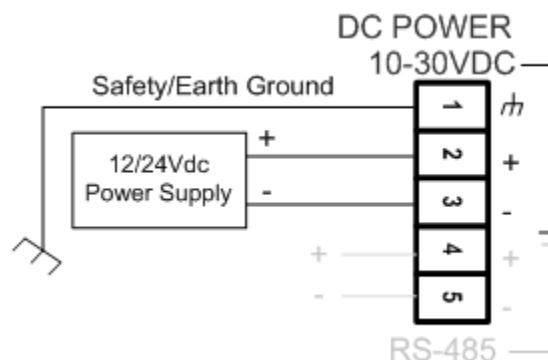
Grounding

The earth ground terminal of the Ascent RTU must have a bonding conductor (14AWG or heavier copper wire) that connects the controller case to the enclosure with less than 0.1 ohms of resistance.

The Ascent module has ventilation slots on the sides of its case. To ensure proper free air circulation and maintain the full temperature rating, the space 1/2 inch immediately to either side of the enclosure must be clear of any other devices.

Ascent Power and I/O

Ascent I/O modules have a five position removable terminal block for power and I/O wiring terminations.



DC Power

Ascent I/O modules require DC power, from 10 to 30Vdc. Input power is applied to the positive (DC POWER +) and negative (DC POWER -) terminals on the terminal block. When the input voltage is below the minimum recommended voltage or reverse polarity power is applied, the Ascent module will turn OFF. Input transients above 36Vdc will blow an internal 2A power fuse, unless an external lower rated fuse is used. An external 1A fast-blow fuse is recommended.

The actual current draw from the DC power supply will vary depending on the Ascent module hardware configuration (Ethernet only, extra serial port option, internal radio option), the software configuration and power saving mode selections, the loop power demand for the analog inputs and outputs, and the number of digital (relay) outputs turned ON. Please refer to the specifications in the back of this manual to determine actual power draw for a given configuration.

System Grounding

In most applications, it's desirable to ground the system by connecting the system power supply common, to the chassis or panel ground. The negative (DC Power -) side of the DC power input terminal as well as all I/O point terminals labeled as commons will then be connected to chassis ground. When using a lightning arrestor with an internal radio option, grounding the lightning arrestor will have the same effect as connecting the DC Power - pin to earth ground.

Universal Inputs Wiring

The Ascent Combo has eight Universal Input channels.. The Universal Inputs accept both analog input and discrete input signals including signals from sensors that monitor levels, flows, temperatures, pressure, etc. as well as discrete input devices such as switches and relays contacts. Built-in signal conditioning eliminates the need for most external signal converters.

Current Mode

In current mode, inputs support loop powered and self-powered 20mA sensors and transmitters.

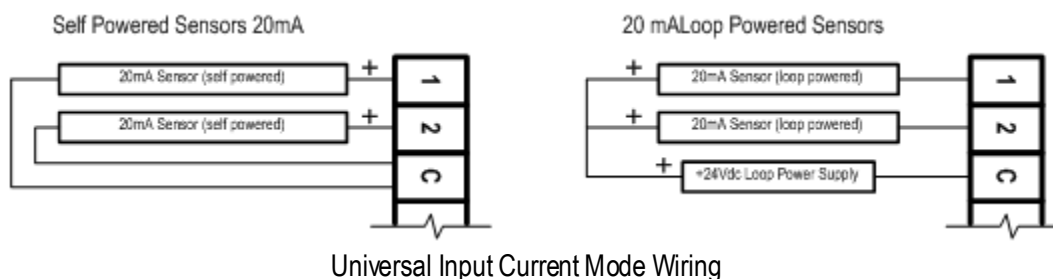
Loop powered sensors are two terminal devices that connect between a loop power supply and the analog input. The loop current continues from the power supply, through the sensor and to ground through precision 45 ohm resistors built into the Ascent module.

Self-powered transmitters have three terminals typically labeled *power in*, *signal out* and *common*. The *signal out* terminal connects to the Analog Input Channel, the *common* connects to GND and the *power in* connects to a power supply (usually the same one that powers the Ascent I/O module).

There are three options for the user when selecting the types of 20mA sensors and loop power configurations. In all cases it is important for the user to ensure that the sensor has enough loop voltage for proper operation, including the voltage drop from any other devices (such as loop powered indicators) that are connected into the

Ascent Combo I/O Module

loop with the sensor. The sensor and other loop-powered device manufacturers supply the minimum operating voltage specification for their devices. The drop across an Ascent Universal input is less than a volt.



Voltage Mode

When configured for voltage measurements, the Ascent RTU measures signals from 0 to 2.25 volts (2 volts plus 12% over-range) with a resolution of just over 16-bits. There is no loss of accuracy in this over-range area, so it's possible to accurately read the signal levels from slightly misadjusted sensors that run "a little hot". It's also possible to distinguish between a sensor that is at full scale versus over-range.

The I/O processor scales and performs calibration correction on the readings, so that a full-scale reading of 2.25Vdc is presented to the main CPU as a value of 22500 (10,000 counts per volt). This provides readings that without further scaling, read out directly in 100uV increments (imagine a decimal point 4 places from the right to interpret the readings in volts).

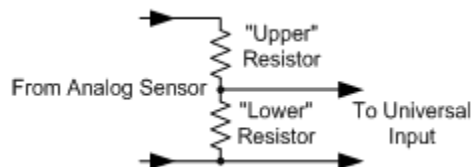
Millivolt Mode

The Ascent RTU can accurately measure very small signal levels like those from "bridge" type pressure transducers and low power devices such as solar radiation sensors. In the Millivolt Mode, the controller has a full-scale measurement range of +/-250mV. The I/O processor scales and performs calibration correction on the low-level readings, so that a full-scale reading of +/- 250mV is presented to the main CPU as a value of +/- 25,000 (10,000 counts per 100mV).

Extended and Bipolar Voltage Measurements

Voltages in excess of 0 to 2Vdc, and sensors that supply a bipolar signal, are supported using a combination of an external precision scaling module (or resistor divider) and the Millivolt Mode. The standard scaling module available from ICL divides the input level by 50, providing a full-scale range of +/- 12.5Vdc. This is ideal for measuring +/-5V and +/-10V process signals.

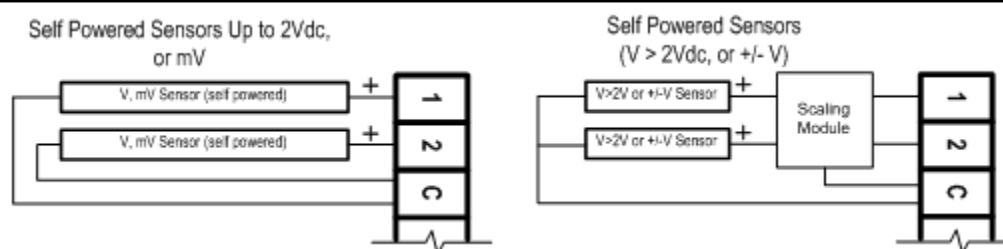
The user can create their own scaling "module" with a pair of precision low-drift resistors in a voltage divider configuration. The voltage "seen" by the Universal Input is calculated as $R_{upper}/(R_{upper} + R_{lower})$.



Typical custom ranges and their corresponding divider values are listed below (these allow for about a 20% over-range capacity and >10K ohm impedance).

Range	"Upper" resistor	"Lower" resistor
+/-5Vdc	12.5K ohm 1%	499 ohm 1%
+/-10Vdc	24.9K ohm 1%	499 ohm 1%

The Scaling section of the Webpage HMI can be used to change this scaling to more meaningful engineering units. See Operations, Universal Inputs, Scaling section for calculating the proper scaling.



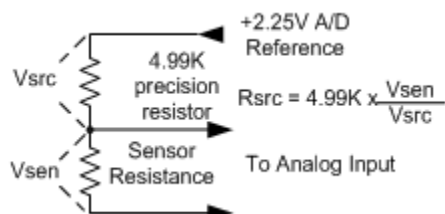
Universal Input Voltage And Millivolt Mode Wiring

Resistance Type Sensors and Measurements

Resistance measurements and resistive type sensors such as thermistors, RTDs and potentiometers (“pots”), as well as sensing contact closures, require a current source. When a resistance type mode or sensor is selected in the Webpage HMI, the controller automatically “switches in” the required current source.

Resistance Modes

The Ascent RTU measures resistance from 0 to 30000 ohms and from 0 to 300000 ohms. The resolution is better than 1 ohm below 13,000 ohms, and up to about 10 ohms or so towards the top of the range. The readings can be scaled in the Webpage HMI from ohms to any set of engineering units. The resistance mode is typically used to read the resistance of potentiometer sensors that indicate position or rotation.



How Resistance Is Measured

Resistance is measured by sourcing current through a precision 4,999-ohm reference resistor that is in series with the sensor. The I/O processor measures the voltage drop at the junction of the reference resistor and the sensor and compares it to the reference voltage. The I/O processor is then able to ratiometrically calculate the sensor resistance. Note that the reference voltage of 2.25 ensures that the source current is less than 0.5mA to prevent sensor self-heating when using sensors with a low thermal mass.

Thermistor Modes

Thermistors are temperature sensors that are popular for use in HVAC, building monitoring and automotive applications. The resistance of a thermistor varies non-linearly with temperature, so the I/O processor in the Ascent RTU automatically corrects for the non-linearity and provides a calibrated reading, in degrees C or F, to the controller.

Ascent RTU’s have internal linearization support for Type II and III 10K ohm thermistors (resistance is 10,000 ohms at 25°C/77°F). These are some of the more common ones used for HVAC applications. The supported temperature ranges and corresponding readings from the I/O processor are:

Sensor	Mode	Number	Range (Degrees C)	Degrees F
Thermistor	10K type II	24	-587 to 2286	-736 to 4434
Thermistor	10K type III	25	-659 to 2485	-866 to 4793

Ascent Combo I/O Module

The table below shows the relationship between the resistance of industry standard Type II and Type III 10K ohm thermistors and temperature. When using thermistors with the built-in scaling, use the manufacturers literature to verify that the sensors that you are using match the table below. Although there is a standard for 10K Type II and Type III thermistors, manufacturers are under no obligation to conform to these standards.

Deg C	Deg F	10K Type II - ohms	10K Type III - ohms
-40	-40	335,671	239,831
-35	-31	242,195	179,280
-30	-22	176,683	135,233
-25	-13	130,243	102,890
-20	-4	96,974	78,930
-15	5	72,895	61,030
-10	14	55,298	47,549
-5	23	42,314	37,316
0	32	32,650	29,490
5	41	25,395	23,462
10	50	19,903	18,787
15	59	15,714	15,136
20	68	12,493	12,268
25	77	10,000	10,000
30	86	8,056	8,197
35	95	6,530	6,754
40	104	5,324	5,594
45	113	4,366	4,656
50	122	3,601	3,893
55	131	2,985	3,271
60	140	2,487	2,760
65	149	2,082	2,339
70	158	1,751	1,990
75	167	1,480	1,700
80	176	1,256	1,458
85	185	1,070	1,255
90	194	916	1,084
150	302	185	238

RTD Mode

RTDs are another form of resistance temperature sensor. They are frequently used in refrigeration and some HVAC applications. Unlike thermistors, the change in resistance per degree of temperature is very small. Therefore RTDs are more susceptible to errors caused by lead resistance. Ascent RTU's support both 2-wire and 3-wire measurement modes for RTDs. The 2-wire mode does not compensate for lead resistance, while the 3-wire mode does. Unfortunately, the 3-wire mode uses an adjacent PAIR Universal Input channels.

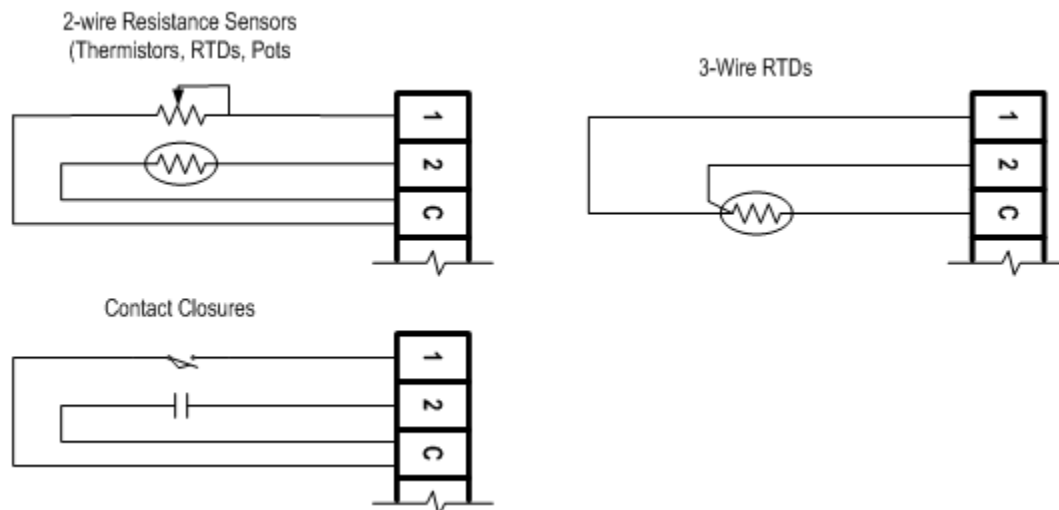
Standard RTDs come in 10 ohm, 100 ohm and 1000 ohm varieties. 100 ohm and 1000 ohm RTDs are typically made from Platinum and used for precision temperature measurements. 10 ohm RTDs are made from copper and usually used to measure the internal temperature of motors for thermal protection, requiring considerably less accuracy.

Although the relationship between resistance of an RTD and temperature is considerably more linear than thermistors, the I/O processor must still linearize the readings to provide accurate calibrated values to the controller. The Ascent RTU supports the following temperature ranges (and provides the following corresponding readings) for 10, 100 and 1000 ohm RTDs:

Sensor	Mode	Number	Range (Degrees C)	Degrees F
RTD 10	3 wire	16	-3200 to 5000	-5440 to 9320
RTD 10	2 wire	17	-3200 to 5000	-5440 to 9320
RTD 100-385	3 wire	18	-2469 to 8894	-4124 to 16329
RTD 100-385	2 wire	19	-2469 to 8894	-4124 to 16329
RTD 100-392	3 wire	20	-2427 to 8700	-4048 to 15980
RTD 100-392	2 wire	21	-2427 to 8700	-4048 to 15980
RTD 1K	3 wire	22	-2469 to 8894	-4124 to 16329
RTD 1K	2 wire	23	-2469 to 8894	-4124 to 16329

Deg C	Deg F	10 ohm RTD	100 ohm RTD	1K ohm RTD
-40	-40	7.49	84.7	847
-30	-22	7.876	88.5	885
-20	-4	8.263	92.2	922
-10	14	8.649	96.1	961
0	32	9.035	100	1000
10	50	9.421	103.9	1039
20	68	9.807	107.8	1078
30	86	10.194	111.7	1117
40	104	10.58	115.5	1155
50	122	10.966	119.4	1194
60	140	11.352	123.2	1232
70	158	11.738	127.1	1271
80	176	12.124	130.9	1309
90	194	12.511	134.7	1347
100	212	12.897	138.5	1385
120	248	13.669	146.1	1461
140	284	14.442	153.6	1536
160	320	15.217	161	1610
180	356	15.996	168.5	1685
200	392	16.776	175.8	1758
220	428	17.555	180.9	1809
240	464	18.335	188	1880
250	482	18.726	191.5	1915

Resistance Mode Wiring



Resistance, Thermistor, 2 Wire RTD, 3 Wire RTD and Contact Closure Wiring

Thermocouple Modes

The Ascent RTU directly supports temperature measurements using thermocouple sensors. No external signal conditioners are needed for any combination of type J, K, T, E, R, S, B and N thermocouples.

Only use ungrounded type thermocouples (electrically isolated junction).

The I/O processor in the Ascent RTU automatically performs linearization and cold-junction compensation to the thermocouple readings. The inputs have upscale burnout protection, forcing a maximum temperature reading for an open thermocouple sensor. The supported temperature ranges and corresponding readings from the I/O processor are:

Sensor	Mode	Number	Range (Degrees C)	Degrees F
Thermo Couple	J	8	-2072 to 12029	-3409 to 21972
Thermo Couple	K	9	-2160 to 13754	-3568 to 25077
Thermo Couple	T	10	-2130 to 4033	-3514 to 7579
Thermo Couple	E	11	-2071 to 10009	-3407 to 18336
Thermo Couple	R	12	-933 to 17930	-1359 to 32594
Thermo Couple	S	13	-858 to 17825	-1224 to 32405
Thermo Couple	B	14	2455 to 18393	4739 to 33427
Thermo Couple	N	15	-2240 to 13035	-3712 to 23783

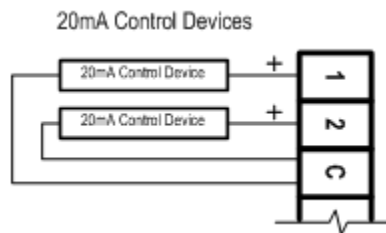
Low-level thermocouple signals can be susceptible to noise. In the Configuration | Universal Inputs | Speed and Averaging pages of the Webpage HMI, the I/O processor can be set to average and filter readings to reduce noise. Since temperatures normally change slowly, averaging can be used to smooth out noisy readings.

Analog Outputs

The Ascent Combo I/O Module has eight analog output channels. These eight outputs are designed to provide either 0 to 20mA or 4 to 20mA process control signals, although with the addition of an external resistor, voltage control signals can be generated as shown below. Analog outputs are used to control variable speed drives, valves, positioners and dampers as well as chart recorders and digital displays.

Current Output

The 24V boost power supply within the Ascent I/O Module powers the eight 20mA analog outputs so that no additional external power supply is required. 2-wire control devices are simply connected between the analog output pin(s) and the common terminal.



Analog Output 20mA Control Devices Wiring

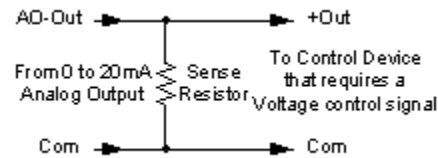
Voltage Output

Using Voltage Input Control Devices with the Ascent Analog Outputs

To obtain voltage outputs, connect a load resistor in parallel with the control device connected to a Ascent Analog Output and GND. The table below lists resistance for three common voltage ranges. The resistance value listed is the parallel resistance of the control device and the load resistor. Normally, the input resistance of the control device is very high and will have negligible effect on the combined resistance.

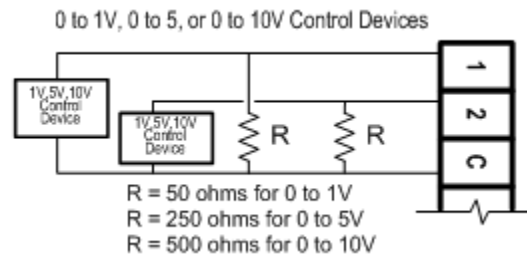
With the addition of a single external resistor (per channel), the outputs can be converted to voltage outputs (i.e. 0 to 5Vdc or 0 to 10Vdc). The resistor value can be calculated as:

$$R_{sense} = V_{out} / 0.02$$



The resistor values required for common output voltage ranges are shown in the table on the left. Standard 1% values of 49, 249 and 499 ohms may be substituted for the “ideal” values shown in the table.

Voltage Range	Resistance
0 to 1V	50 ohms
0 to 5V	250 ohms
0 to 10V	500 ohms



Analog Outputs wired for voltage sensors

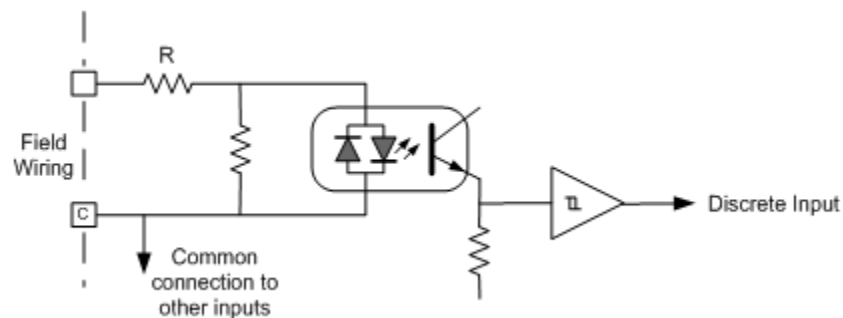
Digital Inputs

The Ascent I/O Module provides ten digital inputs. The status of the ten Digital Input may be displayed on the local HMI for trouble shooting and user information. See HMI Menu section.

Ascent RTU optically isolated Discrete Inputs are used to monitor the state of switches, relays contacts, motor starter auxiliary contacts and any other on/off type signals. The inputs are optically isolated to avoid ground loop effects and support higher voltages (120/240Vac), and prevent damage from transients and power surges on the input lines.

Signal Types and Levels

Ascent RTU Discrete Inputs have a unique bipolar design that accepts both AC and DC signals. The inputs are not sensitive to signal polarity, supporting DC sensors with either “sinking” or “sourcing” output configurations as well as switch contacts with AC or DC signals. A simplified diagram of the Optically Iso lated Discrete Inputs is pictured below:



The value of the input resistor ‘R’ is typically 8700 ohms for 12/24 volt inputs, and 100,000 ohms for 120/240 volt inputs. Note that the Discrete Inputs have hysteresis in order to improve their noise rejection. The hysteresis ensures that the voltage at which an input turns ON is higher than the voltage at which the input will turn OFF. Once the input signal reaches the ON threshold, it must drop down below the OFF threshold for the input to turn OFF. This feature combined with normal component tolerances defines the difference between the OFF and ON thresholds in the table above.

Discrete Input circuitry is purposely designed to respond to DC signals (that do not cross through 0 volts) faster than AC signals. This provides better noise rejection in systems with 50/60Hz control power, but allows for a

Ascent Combo I/O Module

little faster response times in equipment control applications that typically use faster sensors such as DC photo-eyes and proximity switches.

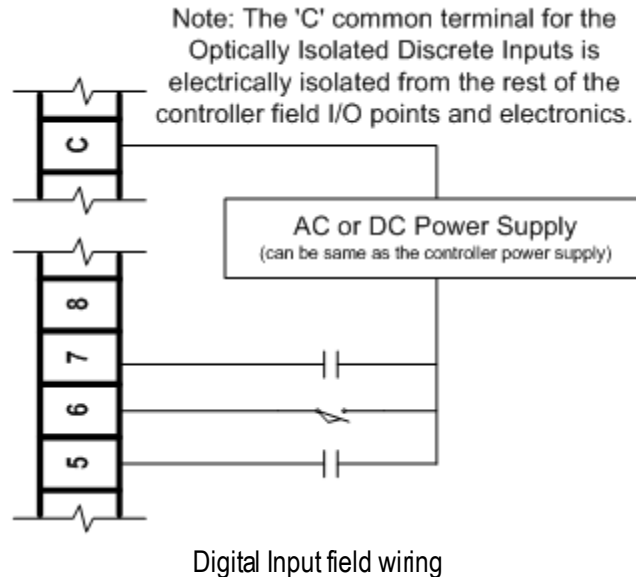
12/24v versus 120/240v Operation

The Discrete Inputs are designed to operate in 12 and 24 volt control systems, or 120V and 240V control systems depending on the model number ordered. The ON and OFF thresholds and maximum input ratings are:

Model Type	OFF Threshold	ON Threshold	Maximum Input
12 / 24V	< 6 Vdc/Vac	> 9 Vdc/Vac	50 Vdc/Vac
120V/240V	< 50 Vdc/Vac	> 75 Vdc/Vac	300 Vdc/Vac

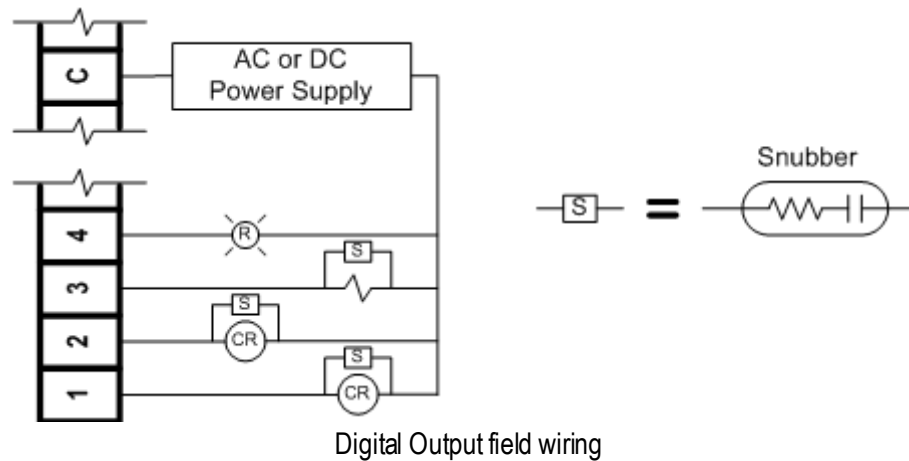
The input current at 12V on 12/24V models, or 120V on 120/240V models is approximately 1 mA, sufficient for contact “wetting”, but low enough for practical use in low-power applications, or applications that require minimal temperature rise. At 24V on 12/24V models, or 240V on 120/240V models, the input current rises to about 2.25mA for each input.

The typical wiring of contact closure type devices to the Optically Isolated Discrete Inputs is pictured below. Note that the inputs are passive and require an active voltage to be switched between input signal connections and the common to complete the input circuits. The inputs are isolated from the rest of the controller electronics. The inputs are not sensitive to polarity, so the power lead connected to the field sensors can be either the negative or the positive side of a DC power source, or either side of an AC power source.



Digital Outputs

The Ascent I/O Module provides ten Digital Outputs. The outputs are dry contact, digital (mechanical relay) outputs. All outputs are Form A (normally open) contacts. Loads can be connected either the high or the low side of the power source. The correct wiring of the Digital Outputs is pictured below. Note that to simplify wiring, all of the outputs share a common (DO-C).



Output Load Considerations

Because relays provide simple mechanical contacts, they are easy to interface to. On the other hand, it is important to understand some of the special considerations required for certain types of loads.

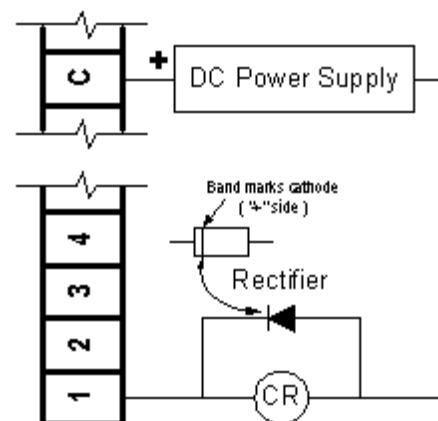
The Ascent relay contacts have a 3 A rating for resistive loads. The rating is lower for other types of loads. For example, incandescent lamps may have inrush currents that will exceed the rated maximum current of the relay contacts since there is a derating specifically for operating these types of lamps. This inrush current may damage the relay contacts, so interposing relays must be used in these situations. If you want to drive incandescent lamps or other non-resistive load, please check the Specifications section to ensure that loads that you need to control do not exceed the relay ratings.

Inductive loads pose another problem. When the current is interrupted to an inductive load (relays, starters, solenoids, etc.), the voltage momentarily spikes up very high. This can cause arcing that damages the relay contacts and eventually causes premature failure. This arcing can also cause radiated noise that disturbs the operation of surrounding equipment. The amount of arcing is not necessarily proportional to the physical size of the device, so even small inductive loads such as “ice cube” relays can be problematic. The solution is to use snubbing diodes for DC systems, and snubbers for AC system. The snubbing device is wired across the inductive load and should be located as close to the load device as possible. Be careful to verify the polarity of snubbing diodes in DC systems as reversing the diode essentially creates a short circuit around the load device.

Example of Snubbing DC Loads

DC Loads can be use low-cost diodes for snubbers. Popular choices are 1N4002, 1N4003, 1N4004 and 1N4007 which are available from virtually any electronic supply house including Radio Shack, and on-line at Digikey.com, Mouser.com and Newark.com. They cost anywhere from 0.07 to 0.99 each, depending on quantity and where you get them from (on-line is generally cheaper).

1N4004	Part#
Radio Shack	276-1103
Digikey.com	641-1311-1-ND
Mouser.com	755-1N4004AT-82
Newark.com	18C8917

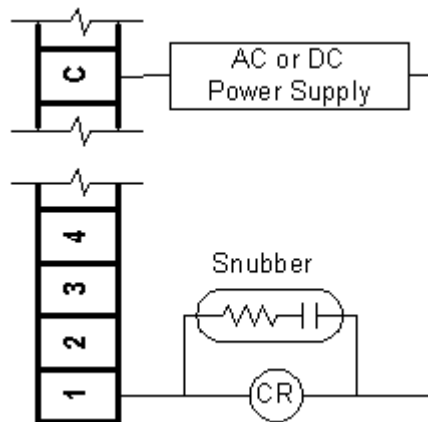


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Example of Snubbing AC Loads

AC Loads require a different type of snubber. There are basically two types commonly used; one that has a resistor and capacitor inside; or some people use a varistor. The varistor solution may be more readily available locally. Be sure to choose a part that matches the AC voltage that you are using. For example, for 120Vac circuits, you can use a V130LA20AP or V130LA20BP varistor which is very popular and fairly easy to find at virtually any electronic supply house including Radio Shack, and on-line at Digikey.com, Mouser.com and Newark.com. They cost anywhere from 0.40 to 1.99 each, depending on quantity and where you get them from (on-line is generally cheaper).

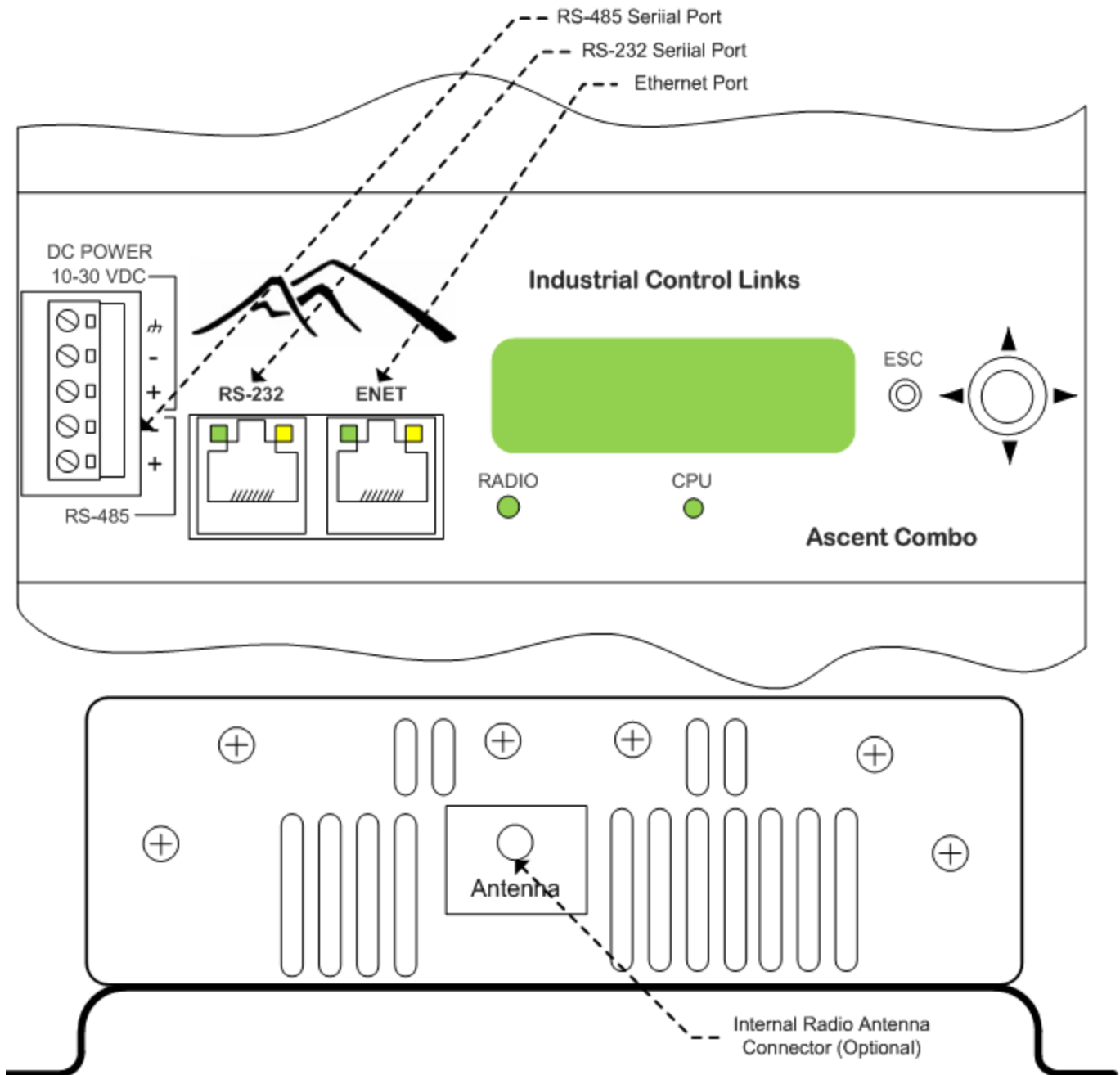
V130LA20AP	Part#
Radio Shack	276-568
Digikey.com	F3030-ND
Mouser.com	576-V130LA20AP
Newark.com	58K7217



CAUTION: DO NOT USE VARISTORS ON AC MOTOR LOADS! Use a motor starter and put a snubber across the coil of the starter.

Communications Interfacing

Ascent I/O Module communication layout:



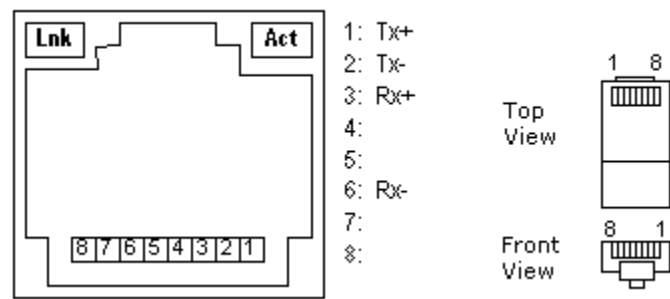
Ethernet Port Connections

Ascent I/O modules have a single high-speed Ethernet port with an industry standard RJ-45 connector that can be connected directly to a wall jack, hub or switch using Category 5 (or better) patch cables. Ethernet provides a reliable low-cost interface that is electrically isolated making it ideal for industrial installations.

The Ethernet connector has two LED indicators in the upper and lower right hand corners. The GREEN LED in the upper left hand corner is the “Link” Status LED. It illuminates when an Ethernet hardware link has been established (the controller is electrically connected to an active Ethernet device). The AMBER LED in the lower right hand corner is the “Activity” Status LED. It illuminates whenever an Ethernet message is transmitted or received.

Ascent Combo I/O Module

The 10/100Base-T Ethernet specification limits the maximum Ethernet cable run to 100m or 350 feet, but the actual limit is based on signal loss and the noise in the environment. This may limit the practical distance to less than 100m or 350 feet. The Ethernet cables should not be run in parallel with power or any cables that generate noise.



Pin connections and status LED locations for the Ethernet (RJ-45) port connector.

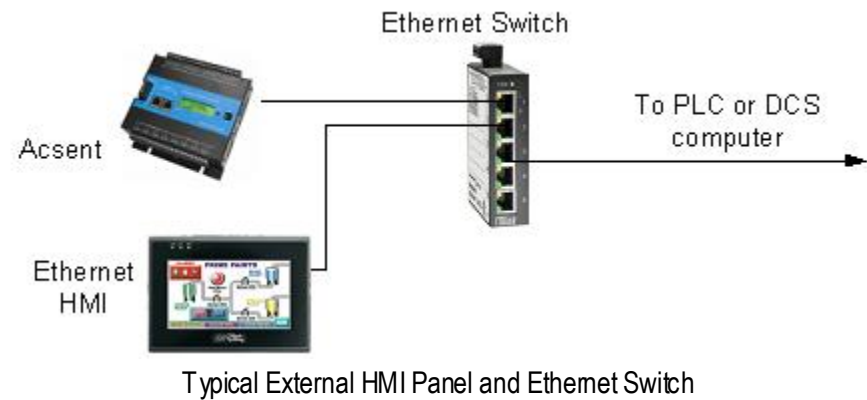
High quality “straight-thru” and “crossover” Ethernet cables are available from Industrial Control Links. The part numbers for these cables are listed in the table below:

Description	Straight Through	Crossover
RJ-45 Ethernet Cable Assembly, 0.5ft. (6")	99-1000	-
RJ-45 Ethernet Cable Assembly, 1ft.	99-1001	-
RJ-45 Serial Cable Assembly, 2ft.	99-1002	-
RJ-45 Serial Cable Assembly, 3ft.	99-1003	99-1103
RJ-45 Serial Cable Assembly, 5ft.	99-1005	99-1105
RJ-45 Serial Cable Assembly, 7ft.	99-1007	99-1107
RJ-45 Serial Cable Assembly, 10ft.	99-1010	-

Ethernet System Configurations

The Ethernet port on the Ascent I/O module supports the 10BASE-T twisted pair standard. When the Ascent module is connected to a single Ethernet device, only a simple low-cost cable with RJ-45 modular connectors on either end is required. Unlike coax based Ethernet, twisted pair Ethernet cannot be “multidropped”. Instead, when more than two Ethernet devices must be tied together, an Ethernet switch or hub is used. These days, mostly switches are used because they cost the same as hubs, are more available, and they eliminate message collisions for higher throughput. Routers and wireless access points typically have at least a 4-port switch built into them.

The Ascent I/O module is not “Auto MDX” compatible, so a “crossover” cable must be used in order to swap the transmit and receive data pairs when connecting a Ascent I/O module directly to a PC computer or other Ethernet device, unless that device supports Auto MDX operation. Most Ethernet switches support Auto MDX operation, so either straight-thru or crossover cables may be used to connect Ascent modules into them.

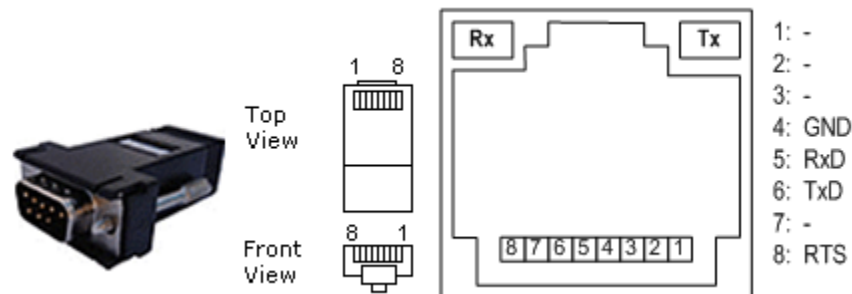


Serial Port Connections

The most common serial communications standards in SCADA and industrial control systems are still RS-232 for short point-to-point connections and RS-485 for longer point-to-point and networked communications. Ascent I/O modules support both standards when ordered with the serial Port option.

The physical RS-232 serial port connection utilizes a standard RJ-45 connector similar to Ethernet connectors. Since Ethernet connections are isolated, no damage will occur if an Ethernet connector is accidentally plugged into a serial port on the I/O module, or vice-versa.

The connector for the optional Ascent Serial Port has two LED indicators in the upper and lower left hand corners. The AMBER LED in the upper left hand corner is the “transmit Data” status LED. It illuminates when a message is being sent to an RS-232 or RS-485 device. The GREEN LED in the lower left hand corner is the “Receive Data” status LED. It illuminates whenever a message is being received from an RS-232 or RS-485 device.



Pin connections and status LED locations for the Ascent RS-232 and RS-485 (RJ-45) serial port.

The wiring of the Ascent RS-232 connector is based upon the EIA/TIA-561 standard. Using standard RJ-45 connectors enables low-cost Ethernet patch cables to be used as high-quality RS-232 cables. RS-232 cables require RJ-45 to DB-9 (male or female) adapters while RS-485 cables. Ethernet patch cables are readily available in a variety of lengths, allowing for a variety of serial communications cable lengths to be “built up” without field without any soldering.

Ascent I/O modules support the following RS-232 serial communications signals:

TxD	Transmit Data (outgoing data from the Ascent I/O module to external devices)
RxD	Receive Data (incoming data from external devices into the Ascent I/O module)
RTS	Request-to-Send (only needed if required by legacy communications devices)
GND	Signal Ground

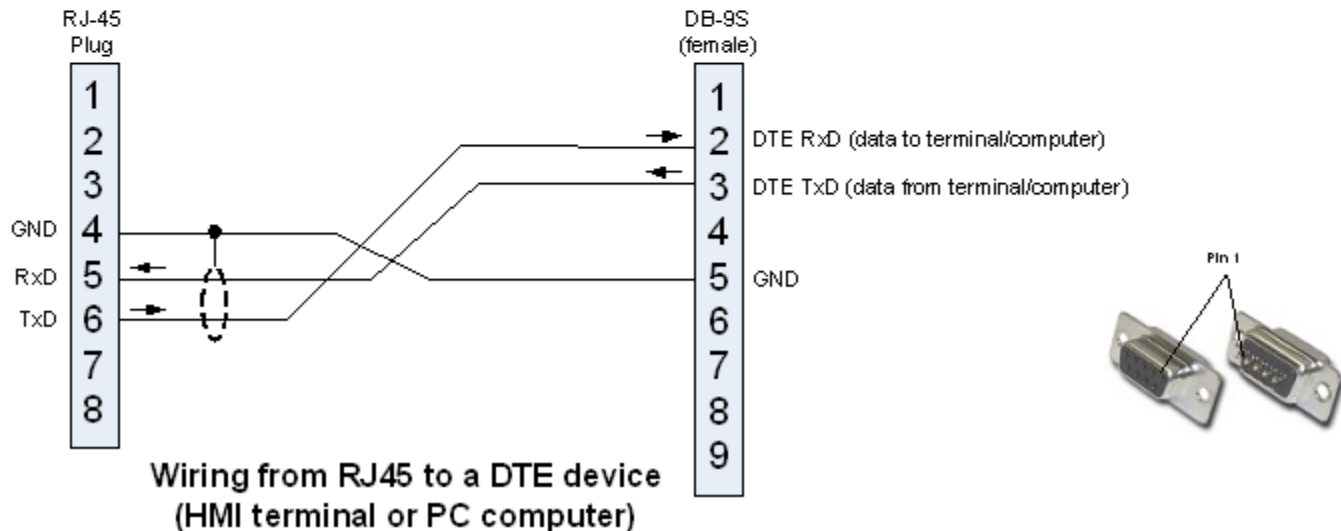
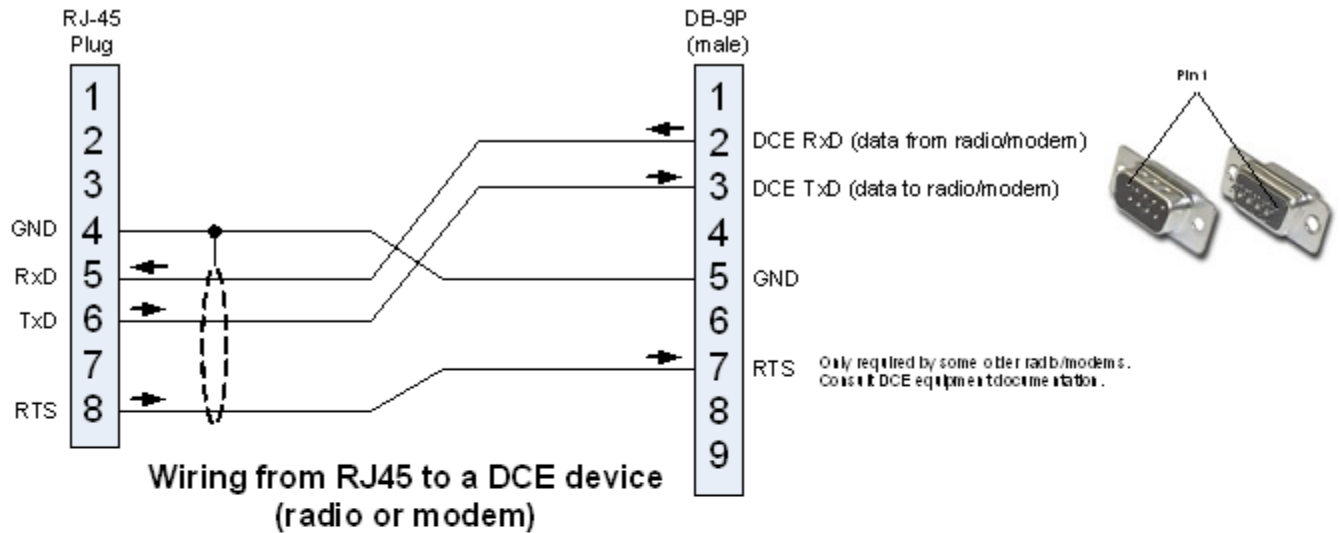
RS-232 Serial Wiring Connections

RJ-45 (8-pin) connections	Ascent DTE Function	DB-9P RS-232 connections
1	-	-
2	-	-
3	-	-
4	GND	
5	RxD	2
6	TxD	3
7	-	-
8	RTS	7

Ascent Combo I/O Module

RS-232 Serial Communications Interface Applications

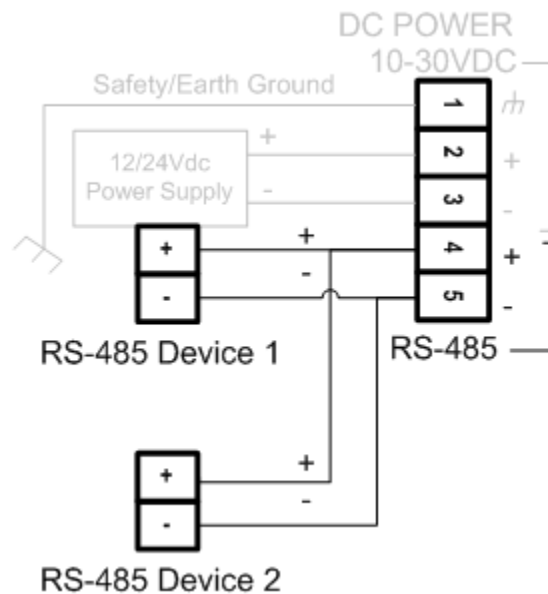
RS-232 is still the most common hardwired communications interface for point-to-point links spanning distances of up to 100 ft. An optional RS-232 interface on the Ascent I/O module is typically used to connect the I/O module to a DCE (Data Communications Equipment) device such as a radio or modem or to a DTE (Data Terminal Equipment) device such as an HMI terminal or PC computer. The cable going to a DCE device normally has a 9-pin D male connector, while the cable to a DTE device is normally a 9-pin female connector as shown below.



RS-485 Serial Communications Interface

RS-485 is a 2-wire communications interface designed to span distances of up to 5,000 ft. and support multidrop networked operation. The Ascent RS-485 interface is typically used for connections to PLCs, HMIs, and I/O expansion modules (such as other Ascent, Ascent, MicroBrick and PicoBrick Distributed I/O modules). Many types of industrial equipment also have RS-485 interfaces and can be used in combination with the Ascent I/O module. Up to 32 devices can share an RS-485 network.

Traditionally, RS-485 networks use a 100Ω resistor termination at each end of the network. This technique does not work well with certain protocols such as Modbus that do not have a lead-in message header to eliminate garbage on the beginning of a message. ICL controllers and I/O modules have series termination resistors that eliminate this problem. In most cases on longer networks, separate termination is not required. If termination is used, it should be AC coupled. Call ICL technical support for additional information if you think that you need additional network termination.



Ascent RS-485 wiring

Ascent Combo I/O Module

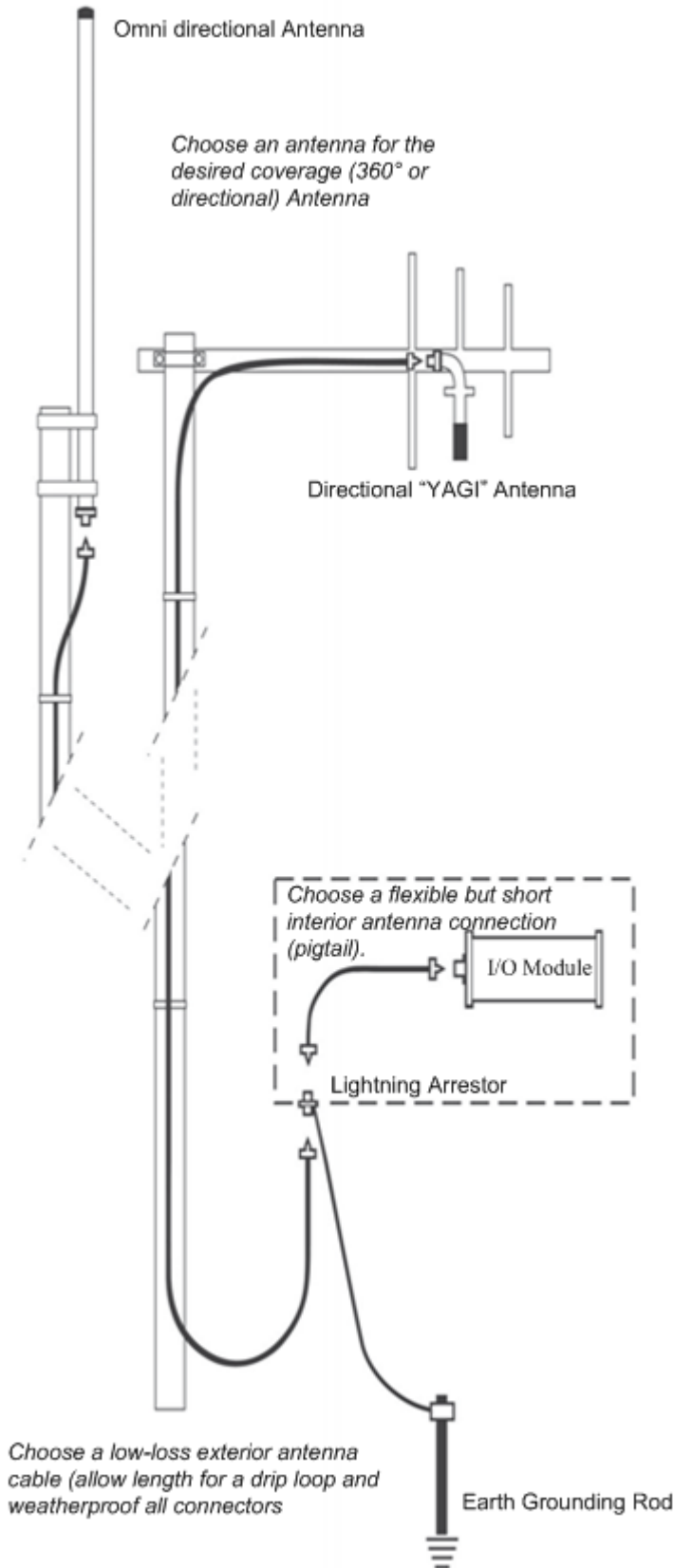
Certified RS-232 Serial Communications Cables

High quality RS-232 modular cables are available for most common applications; prewired and pretested. These certified cables are configured for typical connections to RS-232 DCE devices such as radios and modems that have a 9-pin D FEMALE connector, or DTE devices such as HMI terminals and PC computers that have a 9-pin D MALE.

The part numbers for these cables are listed below:

	RS-232 DCE (DB9S - Female)	RS-232 DTE (DB9P - Male)
RJ-45 to DB9 adapter plug	99-2000	99-2100
RJ-45 Serial Cable Assembly, 1ft.	99-2001	99-2101
RJ-45 Serial Cable Assembly, 2ft.	99-2002	99-2102
RJ-45 Serial Cable Assembly, 3ft.	99-2003	99-2103
RJ-45 Serial Cable Assembly, 5ft.	99-2005	99-2105
RJ-45 Serial Cable Assembly, 7ft.	99-2007	99-2107
RJ-45 Serial Cable Assembly, 10ft.	99-2010	99-2110

Internal Radio Options



Ascent I/O modules can be ordered with a choice of any one of three internal radio options:

Digi Xtend w/MMCX This option provides a Digi Xtend 1 watt 900 MHz spread spectrum radio with a miniature MMCX connector. This option supports the use of a very flexible internal cable to a cabinet bulkhead lightning arrestor. Digi Xtend radios support Point-to-Multipoint as well as Peer-to-Peer and "Mesh" operation.

Freewave MM2 This option provides a Freewave MM2 1 watt 900 MHz spread spectrum radio with a miniature MMCX connector. This option is compatible with all Freewave FGR and (older) DGR series radios. Freewave radios support Point-to-multipoint operation and have enhanced diagnostic capabilities that can be accessed simultaneous with normal I/O communications.

MDS TransNet EL806 This option provides a Microwave Data Systems (GE) 1 watt 900 MHz spread spectrum radio with a miniature MMCX connector.

One of these three radio options fits inside the Ascent module. Ordering an internal radio option does not change the Ascent module's footprint.

Radio Installation

The Ascent radio option uses an MMCX type antenna connector. The antenna connector is located on the side and the radio status light is located on front of the I/O Module.

Typically, a short, lightweight cable connects between the radio antenna connector and a lightning arrestor in the panel. A lightning arrestor with dedicated ground rod is required for any outdoor installation. The lightning arrestor can also serve as a bulkhead connector to pass through the cabinet wall and transition to heavier, lower-loss type exterior antenna cables such as LMR-400 and LMR-600. These cables then connect to Yagi (directional) or Omni (Omni directional) antennas. LMR-600 cable has lower loss for longer runs. LMR-400 is cheaper and more flexible, but less than 100ft. of cable can cut the signal strength in half! Heliax has the lowest loss, but is stiff and hard to work with.

Antenna and System Configuration Options

Depending on the distance and terrain between sites, there are multiple options for antenna connections to Ascent modules internal radio:

Ascent Combo I/O Module

Option 1 – Enclosure Mounted Antenna

If the distance between sites is moderate (less than a mile) with clear line of sight, then an enclosure mounted antenna may be an option. We generally recommend a “salt shaker” style transit antenna which is omni-directional with 3dB of gain. The antenna is typically installed in a hole in the top of the box and a short internal antenna cable links the radio with the antenna. The antenna has a waterproof gasket. Generally, no lightning arrestor is needed since the antenna is only slightly above the top of the enclosure.

Part numbers: “salt shaker” antenna

Internal Antenna Cable Part Number

98-6424 24" Internal Antenna Cable: MMCX to N-Male (Xtend Freewave MM2 or Xtend with MMCX)

Enclosure Mounted Antenna Part Numbers

98-3113 3dB OMNI "Salt Shaker" Transit Antenna, Type-N Female, 902 to 928 MHz

Option 2 – External Antenna

If the distance between sites is beyond the limits for the first two options, or there is not a clear line of sight, then a full antenna system is recommended. This includes:

- An internal antenna cable
- A lightning arrestor
- An external antenna cable
- A Yagi (directional) or Omni (omnidirectional) elevated antenna

We also generally recommend a computer Radio Path Survey that uses GS coordinates of the radio sites along with precision topographical map data to calculate the performance of the radio system, and determine the required antenna elevations. Most commonly used components are:

Internal Antenna Cable Part Numbers

98-6424 24" Internal Antenna Cable: MMCX to N-Male (Xtend Freewave MM2 or Xtend with MMCX)

98-6524 24" Internal Antenna Cable: RPSMA-Female to N-Male (XTend)

Lightning Arrestor Part Number

98-8001 Lightning Arrestor, 900MHz, bulkhead mount, N-Female to N-Female

External Antenna Cable Part Numbers

98-4010 10ft. External Antenna Cable, LMR-400, N Male to N-Male connectors

98-4020 20ft. External Antenna Cable, LMR-400, N Male to N-Male connectors

98-4030 30ft. External Antenna Cable, LMR-400, N Male to N-Male connectors

98-4050 50ft. External Antenna Cable, LMR-400, N Male to N-Male connectors

98-4075 75ft. External Antenna Cable, LMR-400, N Male to N-Male connectors

98-4100 100ft. External Antenna Cable, LMR-400, N Male to N-Male connectors

External Antenna Part Numbers

98-2106 6dB YAGI Directional Antenna, Type-N Female, 896 to 940 MHz, w/mtg hardware

98-3106 6dB OMNI Fiberglass Antenna, Type-N Female, 896 to 940 MHz, w/mtg hardware

Setting Digi Radio Option Parameters

The I/O Configuration Tool will allow you to set any radio parameters you wish through the terminal interface.

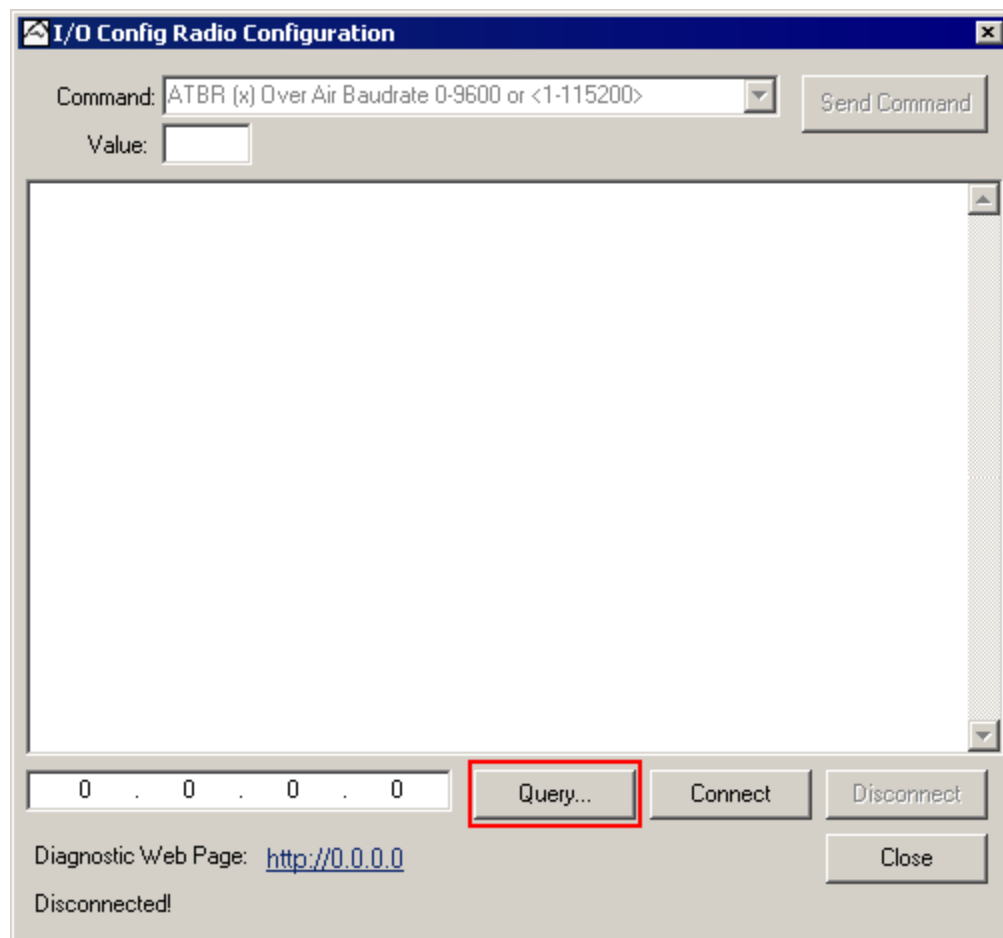
This procedure will detail setting the following parameters:

- Over-the-air baud rate (ATBR)
- Port baud rate (ATBD)
- Hopping channel (ATHP) -- this is also the Network ID
- Blind multi-transmit ATMT

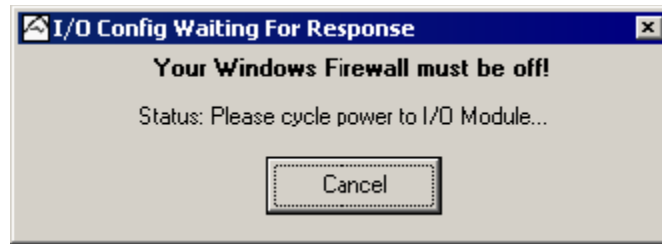
To get to the terminal interface, click on the RADIO CONFIGURATION button.



You will see a terminal window like this:



Click the Query button above. The system will prompt you to cycle power to the unit:



The terminal is then ready to connect to the RTU's radio, click the CONNECT button:



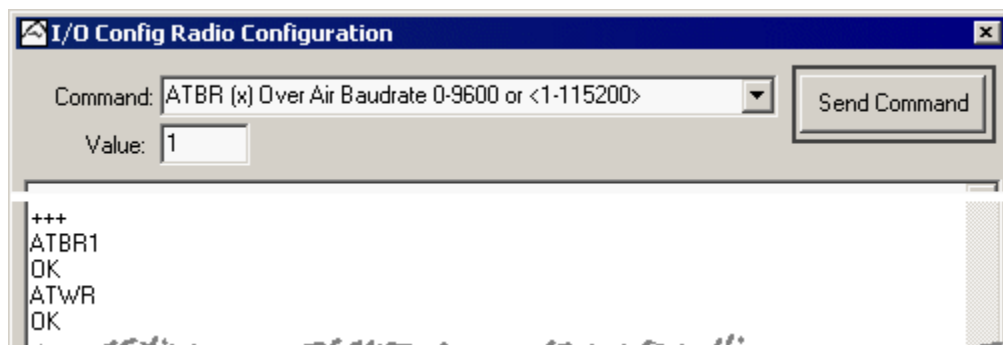
You should see a series of commands and responses:



Setting The Over-The-Air Baud Rate

**** This parameter must match all the other radios that want to communicate with this unit. ****

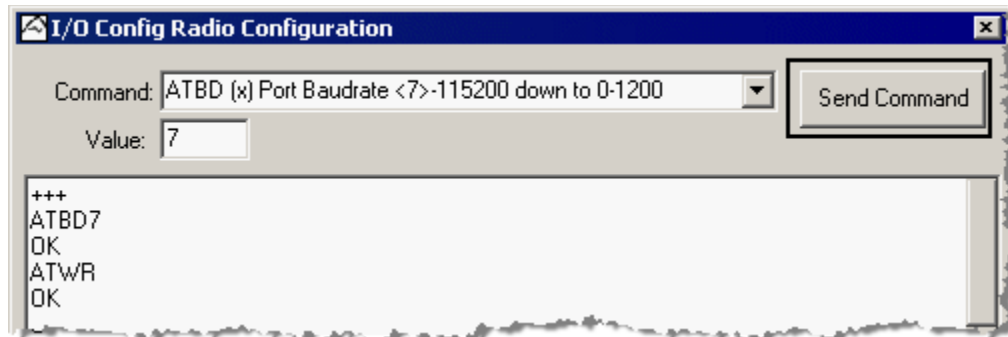
From the Command Combo Box, select the ATBR (x) command. Enter 0 for 9600 or 1 for 115200 in the value field and click the SEND COMMAND button:



Setting The Port Baud Rate

**** This parameter is almost always set to 115200 and is the RTU <-> Radio internal link ****

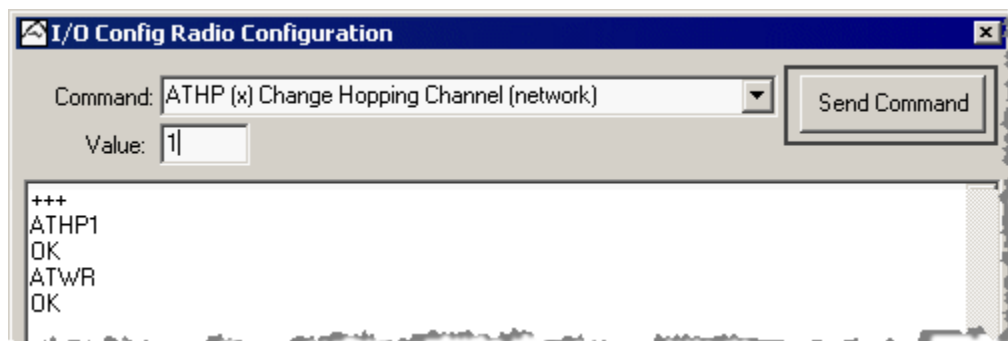
From the Command Combo Box, select the ATBD (x) command. Enter 7 for 115200 in the value field and click the SEND COMMAND button:



Setting The Hopping Channel

**** This parameter must match with all radios that communicate with this RTU! ****

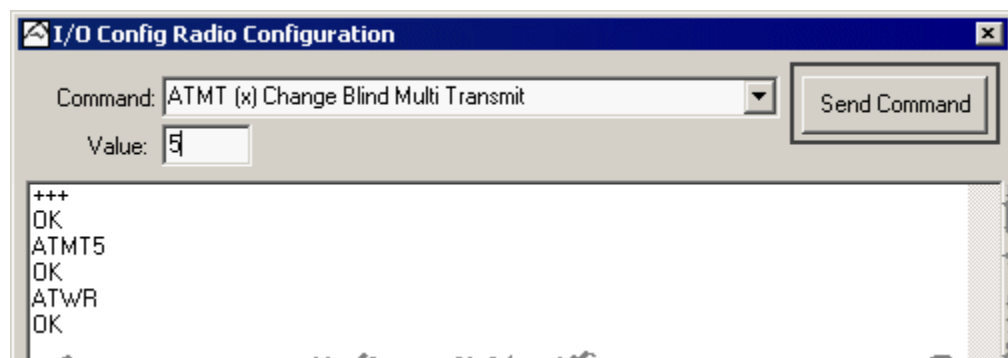
From the Command Combo Box, select the ATHP (x) command. Enter the hop ID desired and click the SEND COMMAND button:



Setting The Blind Multi Transmit Parameter

**** This parameter sets the blind packet retries at the radio level ****

From the Command Combo Box, select the ATMT (x) command. Enter the number of repeat packets desired and click the SEND COMMAND button:



For further configuration information on the Digi Xtend, please see the following link:

<ftp://www.iclinks.com/TechSupport/DigiXTend/DigiXtendRadioManual.pdf>

Setting Freewave Option Parameters

For this configuration, you will need a serial terminal such as Hyperterminal, Procomm Plus or ICL's ScadaBuilder Terminal. Connect to the unit with a Null modem connector (see [Serial Port Connections](#) section for pinout of a NULL modem cable). Set the terminal to 19200, 8 databits, none parity, and 1 stop bit.

Turning On The Radio Diagnostics

Get connected to the Web HMI (see [Web HMI](#) section).

To enable radio diagnostics go to [Configuration](#) | [Communications](#) | [Radio Diagnostic](#) | Diagnostic Mode: [x] and check the box and click Update. This mode will be reset when you cycle power to the unit.

Open your terminal to your PC's comport

Once connected hit <SHIFT> <U>

You should see the menu pictured below. Pressing the Escape key several times will cause the radio to return to normal operation.

Radio Configuration - MAIN MENU

When the radio has been placed into configuration mode then the Main Menu screen will be displayed:

```
MAIN MENU
Version 2.23 11-21-2002
Standard Hop Table
Modem Serial Number 911-8743

(0) Set Operation Mode
(1) Set Baud Rate
(2) Edit Call Book
(3) Edit Radio Transmission Characteristics
(4) Show Radio Statistics
(5) Edit MultiPoint Parameters
(6) TDMA Menu
```

Radio Configuration - SET OPERATION MODE

The "Set Operation Mode" screen is selected by pressing "0" at the Main Menu. In this screen, the radios basic operating mode is chosen. The screen is depicted below:

```
SET MODEM MODE
Modem Mode is 2

(0) Point to Point Master
(1) Point to Point Slave
(2) Point to MultiPoint Master
(3) Point to MultiPoint Slave
(4) Point to Point Slave/Repeater
(5) Point to Point Repeater
(6) Point to Point Slave/Master Switchable
(7) Point to MultiPoint Repeater
(F) Ethernet Options
(Esc) Exit to Main Menu

Enter Choice
```

The current operating mode for the radio is always shown at the top of this screen just under the title header. Of the 9 available operating modes, only three of the modes—Point to Multipoint—are typically used with the Pinnacle Series controllers.

Point to Multipoint Master

In this mode, there must be **one, and only one Master radio** in a system. All of the other radios in the network will operate as slaves to the Master. Designate one radio as the Master using selection #2 in the menu.

Point to Multipoint Slave

After a single radio has been designated as the Master, the remaining radios in the network must be set as “Slaves” using selection #3 in the menu.

Point to Multipoint Slave/Repeater

To reach outlying areas in the network, the Slave radios can act as repeaters. Slave radios that will also act as repeaters are configured using selection #7 (Point to MultiPoint Repeater) in the menu. Be sure to also enable Slave/Repeater operation in Menu #5.

Return to the Main Menu

Once a radios mode has been set, press the ESC (escape key) to get back to the Main Menu (only press once, or else you will end up out of diagnostic mode and will need to do the SHIFT-U operation again).

Radio Configuration - SET BAUD RATE

The “Set Baud Rate” screen is selected by pressing “1” at the Main Menu. In this screen, the radio's basic serial communication parameters are chosen. The screen is depicted below:

SET BAUD RATE
 Modem Baud is 115200

(0)	230,400	
(1)	115,200	
(2)	76,800	
(3)	57,600	
(4)	38,400	
(5)	19,200	
(6)	9,600	
(7)	4,800	
(8)	2,400	
(9)	1,200	
(A)	Data, Parity	0
(B)	Modbus RTU	1
(C)	RS232/485	0
(D)	Setup Port	3
(E)	Turn Off Delay	0
(F)	Flow Control	0
(Esc)	Exit to Main Menu	

Turn On Delay 0

Enter Choice

The current communications speed (baud rate) setting for the radio is always shown at the top of this screen, just under the title header. The baud rate can be set to any one of ten standard speeds by simply typing a 0 through 9 corresponding to baud rates of 1,200 baud to 230,400. Any of these speeds may be used with the Pinnacle Series controller. The speed selected **MUST** match the port speed selected using the ScadaBuilder configuration software as defined in the “Radio” Network Port in the controller’s application.

Parity

The radio supports the standard “Odd, Even or None” parity selections. For most applications including those using Modbus, 0 or “None” should be used.

Modbus RTU

This parameter should normally be set to “1” (enabled), forcing the radio to keep the integrity of a single message as one packet instead of using multiple packets which does not meet Modbus standard timing requirements.

Ascent Combo I/O Module

Setup Port

Set this parameter to 3. This enables both radio ports for configuration. This should be set by the factory already.

Radio Configuration - EDIT RADIO PARAMETERS

The “Edit Radio Transmission Characteristics” screen is selected by pressing “3” at the Main Menu. The screen, with typical settings for a Pinnacle Series based SCADA system, is depicted below:

```

                                RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0)   FreqKey           5
(1)   Max Packet Size   8
(2)   Min Packet Size   9
(3)   Xmit Rate         1
(4)   RF Data Rate      3
(5)   RF Xmit Power     10
(6)   Slave Security     0
(7)   RTS to CTS        0
(8)   Retry Time Out    255
(9)   Low power Mode     0
(A)   High Noise        0
(B)   MCU Speed         0
(C)   Remote LED        1
(Esc) Exit to Main Menu

Enter Choice
```

The parameters in this menu are geared towards handling special circumstances and should normally be left as shipped from the factory. Most of the parameters in this screen are used to optimize the radios operation in the event of problems in the field. They improve the operation of the radio in close proximity with other radio networks, in high (radio) noise environments, or to optimize the operation of the radio for certain mixes of data or types of protocols. In general, the radios are plug-and-play and these parameters are best left at the factory settings unless a technical support person recommends changing them. Typically, your radio setup should match the screen pictured above.

Radio Configuration - SHOW RADIO STATISTICS

The “Show Radio Statistics” screen is selected by pressing “4” at the Main Menu. The screen is depicted below:

```

                                MODEM STATISTICS

Master-Slave Distance (m) 0083200

Number of Disconnects      0
Radio Temperature          0
Antenna Reflected Power    0
Transmit Current (mA)      0000
                                Local   Remote1   Remote2   Remote3
Average Noise Level        12
Average Signal Level       0
Overall Rcv Rate (%)       0
C086EF

Press <ret> for Freq Table, <Esc> to return to main menu
```

The radio statistics screen shows an accumulated history of information regarding the performance of the radio and the quality of the radio link. Unlike the “real-time” updated information available at the Master, this information is a snapshot that can only be viewed while not operating, but it does provide a local tool to analyze the performance of a radio link.

Master-Slave Distance (m)

This value in meters is valid for distances over 1 Km (0.6 miles)

Radio Temperature

Should be 75 (°C) or less.

Average Noise and Signal Levels

These values are an average across all frequencies. Detailed information by frequency is available by displaying the Frequency Table accessed from this screen (see lower prompt line). Ideally, the noise level should be below “30” and the signal level should be at least “15” more than the noise. Note that this is NOT in dB, but arbitrary units to provide a relative signal strength and noise measurement.

Overall Rcv Rate (%)

This value provides an indication of the quality of the radio link and the impact on data throughput. A good quality link will have an Overall Receive Rate of 75% or better. The radio will not pass erroneous data, but a lower Overall Receive Rate indicates that data throughput might be affected at higher data rates, such as 115,200 baud.

Radio Configuration - EDIT MULTIPOINT PARAMETERS

The “Editing MultiPoint Parameters” screen is selected by pressing “5” at the Main Menu. The screen, with typical settings for the Pinnacle Series, is depicted below:

MULTIPOINT PARAMETERS		
(0)	Number Repeaters	1
(1)	Master Packet Repeat	3
(2)	Max Slave Retry	9
(3)	Retry Odds	9
(4)	DTR Connect	0
(5)	Repeater Frequency	0
(6)	Network ID	30
(7)	Reserved	
(8)	MAdvantaster Sync	0
(9)	1 PPS Enable/Delay	255
(A)	Slave/Repeater	0
(B)	Diagnostics	0
(C)	SubNet ID	Disabled
(D)	Radio ID	Not Set
(Esc)	Exit to Main Menu	
Enter Choice		

Number of Repeaters

Repeaters extend the range of a radio network at the expense of speed. Any radio can also serve as a repeater. Set this parameter to 1 if you are using ANY repeaters. All radios in the network must have the same setting.

Master Packet Repeat

With a high quality link, set to 0 or 1 for maximum throughput. With a poor quality link, a higher number will improve getting individual messages though at the expense of speed and throughput. For Modbus networks, this value must be set to 3.

Network ID

This parameter helps avoid conflicts with other radio networks. All radios in the network should be set to the same ID value. Other networks must use a different value. Set this to any value below 4095, except the default (255).

Slave/Repeater

Set to 1 if this radio is a repeater as well as a node on the network. Be sure to set the Modem Mode (Menu #2) to (7) Multipoint Repeater also.

Diagnostics

Set to 1 for this radio to provide diagnostic data back to the Master.

The Freewave FGR manual can offer more detailed configuration. It can be downloaded from:

<ftp://www.iclinks.com/TechSupport/Freewave/FreewaveFGR.pdf>

Modbus Communications

I/O modules support the Modbus RTU/TCP/UDP communications protocol. This protocol was originally developed for Modicon Programmable Logic Controllers (PLCs). Now, Modbus is supported by nearly any PLC and RTU, and most HMI/MMI software packages. The modules can be used in a large number of existing systems and will work without special drivers with many different “Hosts”.

I/O modules support the following four standard Modbus data types:

Data Type	Modbus Type	Description
Status	10xxx	Read Only bits
Coils	00xxx	Read/Write bits
Input Registers	30xxx	Read Only 16-bit values (two combined for 32-bit values)
Holding Registers	40xxx	Read/Write 16-bit values (two combined for 32-bit values)

Note: Do not confuse the Modbus Type with the command codes used to access the various data types.

Both the single and multiple element forms of the Modbus commands that access these data types are supported. For example, there is a command to read or write a single Holding Register, and another command to access a block of Holding Registers. The I/O support both command types.

All totalizers are 32-bit registers. These registers are accessible as two consecutive 16-bit Modbus registers. The Most Significant (high order) portion of the 32-bit value is accessed in the first register, immediately followed by a second register with the Least Significant (low order) portion of the 32-bit value. 32-bit values should always be accessed with the Read/Write multiple registers form of Modbus messaging so that both portions of the 32-bit value are read together in a single message.

I/O modules allow up to 128 registers of any type to be accessed in a single message. Be careful to only access valid registers. In general, messages that access unassigned registers are rejected as invalid messages, unless they are reserved for future use.

Detailed information on the Modbus protocol is available at: www.modbus.org

For a detailed register map, see the [Modbus Map](#) section

Network Addressing

I/O modules have a web page configuration interface for viewing and changing the Modbus network address. The network address may also be changed via a Modbus holding register. In order to simplify this setup function, I/O modules always respond to address 255 regardless of the current network address setting. Do not use 255 as an address in a network! Address 0 is also not supported and should not be used.

Modbus Store & Forward (serial and radio interfaces only)

I/O modules can be used as Remote Terminal Units (RTUs) in radio based systems. To extend the effective range of radio systems, they may be configured to digitally repeat messages destined for other I/O modules or controllers that are not directly accessible to the Modbus Master. Although the Modbus standard has no definition for this function, I/O modules use a simple form of block address translation to support Store & Forward operation within the Modbus specification framework.

The following “rules” are used for Store and Forward operation:

The network addresses to be translated and forwarded must be in a single contiguous block.

The translated addresses must be unique and NOT include the local RTUs address.

The Master must be capable of ignoring the messages generated with translated addresses (ICL controllers do this automatically). Some Modbus Masters may not like seeing what appears to be a response message with a

different address. Since the repeater is by definition “in radio range”, the Master is certain to “see” these messages.

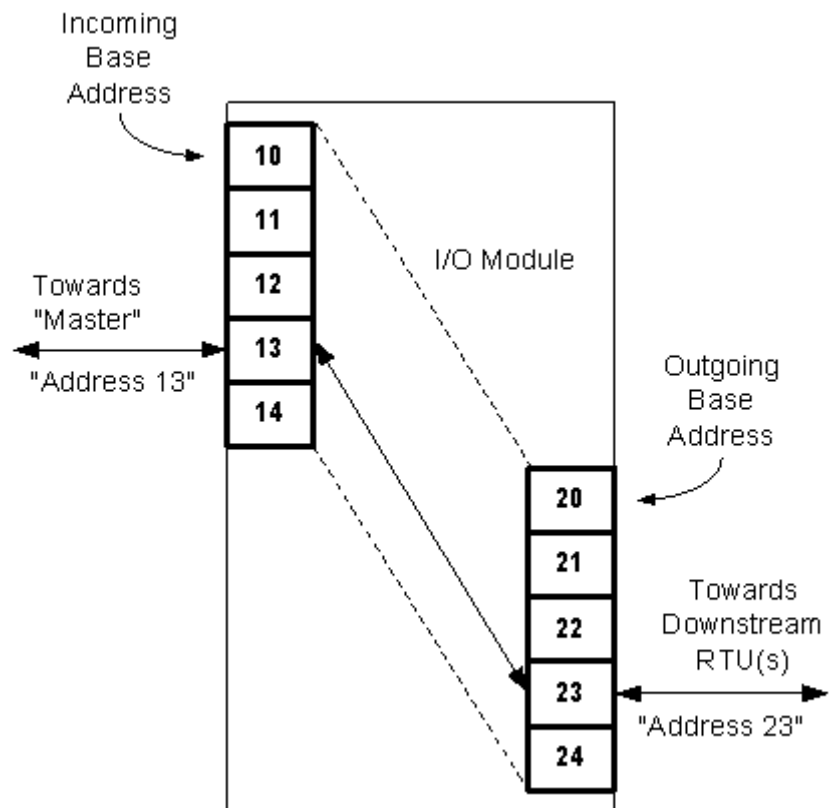
I/O modules have three holding registers that control the Store and Forward address translation functions; an “In Address” register, an “Out Address” register, and a “Block Size” register.

When a message is received by a I/O module, it first checks to see if the message is intended for itself. If not, it then checks to see if the message falls within the Incoming range of addresses (Incoming Base through Incoming Base + Block Size - 1) or within the Outgoing range of addresses (Outgoing Base through Outgoing Base + Block Size - 1).

If a message falls within the Incoming Range, then the RTU knows that the message came from the Master (or a previous repeater en route from the Master) and it translates the address to the Outgoing Range, calculates a new message CRC check block, and retransmits the modified message. Likewise, if a message falls within the Outgoing Range, then the RTU knows that the message came from a downstream RTU (or a previous repeater) and it translates the address to the Incoming Range, calculates a new message CRC check block, and retransmits the modified message back towards the Master.

There is no limit to the number of repeater hops that can be used other than the total number of available addresses (255).

The Store and Forward translation process is pictured below.



Modbus Message Store and Forward Address Translation

In this example, the Incoming Base Address is set to “10”, the Outgoing Base Address is set to “20”, and the Block Size is set to “5”.

A message that comes from the direction of the Master with an address of “13” is translated to an address of “23” and rebroadcast. Likewise, when the downstream unit responds, the message will come from address “23” and be translated and rebroadcast as address “13”. As far as the Modbus Master is concerned, it is communicating with address “13”, but with some additional delay caused by the repeating process.

Secure Data Exchange (SDX) Communications

SDX Protocol

The Pinnacle series of controllers now supports ICL’s Secure Data Exchange protocol otherwise known as SDX. This interface can talk over RS-232, RS-485, radio, dialup as well as Ethernet (UDP) ports. It is a 128 bit AES encrypted protocol with a 16 character user defined key. All units communicating on the same network must be configured with the same 16 character key. Up to 65535 addresses may be used in a single network.

RTU Compatibility

SDX is also fully compatible with the Ascent, Sprite, and Solaras I/O modules available from ICL. With a small amount of configuration, Pinnacle controllers may also receive quiescent messages from these remote units

even though they are not programmable. The remote units may send data periodically or based on change of state or change of level.

SDX Routing

SDX messages may be routed through any SDX compatible units up to four hops (repeaters). No extra configuration is necessary as the initiating unit defines the routing information at transmission time. The “route” information is encrypted in the message and used by any SDX remote the message is addressed to. By definition, any SDX remote or controller is a router. The remotes, when receiving a routed message, will automatically turn the message around and use the same remotes to route the response back to the initiating “master”.

SDX Objects, Message Efficiency, and Data Security

SDX is also capable of combining multiple data types into one message. In most traditional protocols, only one data type can be transacted at any given time. SDX is object oriented where not only is each data type an object but also each I/O type can also be an object. If there are several object types to be sent to a particular unit, SDX can combine the object types into one message eliminating the need for multiple transactions—this saves on the amount of air time consumed over a radio system for example. All this is done over AES 128 bit encryption so all of the data is safe and secure. After the data is decrypted by the AES engine with the 128 bit (16 character) key, it is checked again by two Cyclic Redundancy Checks (CRC’s), one for the transport layer then one for the object layer (data content layer). Only when both of these CRC tests have passed, will the remote or master unit receiving the message begin to parse the actual object data.

Setting Up Dynamic DNS

DNS

To explain Dynamic DNS, one must first explain DNS (Domain Name System). When you type an address into the address field of your browser (or click on a link in a web page), before the page can load, the name you typed is submitted to your Domain Name System server and a lookup is done using the domain portion of the address. Examples of domain names are “yahoo.com”, “google.com” and our favorite “iclinks.com”. The “www.” of the address usually applies to a specific server (computer) at the domain itself. For example, “www.yahoo.com” can be a different IP address than “mail.yahoo.com” even though they are technically on the same domain.

There is more to this than just making the IP address more palatable to our eyes and memory. If the underlying IP address changes, the same server name can be used for the new IP address. The end user never sees that the IP address has changed and has no real need to. This is the primary purpose of the DNS protocol.

User enters the DNS name.

The browser sends the name to the DNS server.

DNS server looks up the IP address.

The IP address is returned to the browser.

The browser then gets the page information requested from the IP address.

Most servers out on the Internet use a static IP address to identify themselves to the rest of the Internet which means the IP addresses change little unless the owners change providers or reconfigure their own networks.

DHCP

The purpose of Dynamic Host Control Protocol is to not only simplify the tracking of IP addresses, Gateways, Network Masks and DNS Servers but also to reuse the limited number addresses on the Internet. For this reason your Internet Service Provider (ISP) prefers that you use dynamic IP addresses that it provides and charges less for them than static IP addresses. Since most Internet connections (browsers) are clients, this works fine for most users. When using a controller or an I/O module however, it is far more likely that either of these devices need to act as servers so that I/O and other data they contain can be accessed from the outside world. When using DHCP, it is possible to access your IP address even though it is “dynamic”. With Dynamic DNS, a name

is provided by a DDNS server that will be applied to whatever IP address your I/O module or controller is given.

Dynamic DNS

The purpose of Dynamic DNS applies to dynamically obtained IP address on the Internet. It allows a non static IP address to be used as a named server to access an I/O module or controller residing behind a router or firewall. This address can change anytime the router/firewall gets disconnected or powered down. All that is required to utilize this functionality is a free account on a Dynamic DNS server. ICL modules can easily utilize and have been tested with two different DDNS servers: No-Ip.com and DynDNS.com.

In the examples below, you must use your own usernames, email addresses and passwords. These parameters below are strictly examples.

DDNS on No-Ip.com

Setup an account with No-Ip.com. This requires a valid email address, a password, your name, and some answers to a security questions. You will receive an email to confirm your account. Click on the activation link and activate your No-Ip account.

Goto www.no-ip.com and log in with your email address and password you used above. In this example, we are using ascent@hotmail.com and mypassword—you should use your own email and password.

Click on “Add a Host”.

Enter a Host Name for this example we are using “ascentmaster”

Select a domain name- for this example we are using “no-ip.org”

This will give you a domain name of “ascentmaster.no-ip.org”.

Get to the web page configuration (see [Web HMI](#) section)

Go to [Communications | DDNS/DHCP](#)

Check the DDNS Enable: ☒ checkbox

Enter the **Hostname** (ascentmaster.no-ip.org)

Enter your email address in the **Username** field (ex. ascent@hotmail.com)

Enter your **Password** above (ex. mypassword)

Enter the **Server** for no-ip.com which is “dynupdate.no-ip.com/nic/update”

Click the Update button.

DDNS on DynDNS.com

Goto www.dyndns.com

Enter a free domain name and click Add

Enter a Username, they will not accept an email address.

Enter a Password (ex. mypassword).

Enter an email address (ex. ascent@hotmail.com)

Enter the security information

Click Create Account

You will receive an email on the account given

Click on the link to complete the account creation process.

To check your setup, go to the [Testing Your DDNS Configuration](#) section.

Get to the web page configuration (see [Web HMI](#) section)

Go to [Communications | DDNS/DHCP](#)

Check the DDNS Enable checkbox

Enter the **Hostname** (ascentmaster.dyndns.org)

Enter your account **Username** (from the first step when you created your DynDNS account)

Enter your **Password** above (mypassword)

Enter the **Server** for dyndns.com which is “members.dyndns.org/nic/update”

Click the Update button.

Ascent Combo I/O Module

Testing Your DDNS Configuration

Be sure that you have a static IP on your internal network and that your Network Mask, Gateway, and DNS Server are setup properly to get out to the Internet.

Power cycle the unit to get it to send out the DDNS login. You can check to see that it was successful in several ways. Go to the [User Home](#) page and click on the [Status](#) link. On this page is a item called “Response Code”—this item should read 1000. If there was an error logging on to the no-ip.com server, then a 2000+ error will be displayed:

1000	DDNS_GOOD	Dynamic DNS Service has been successfully updated.
2000	DDNS_NoDNS	Aborted DDNS Server IP is 0.0.0.0 or the Dynamic DNS Server name is blank
2001	DDNS_BadResponse	DDNS Service got a Bad response from the Dynamic DNS Server
2002	DDNS_Timeout	DDNS Service was aborted because of a bad configuration or timeout
2100	DNS_BadResponse	Bad response from DNS Server
2200	DHCP_Timeout	DHCP did not finish. We will retry again

Open a command prompt in windows and type nslookup <yourname.yourselecteddomain>. An IP address should come back confirming that the lookup is successful.

Opening the Ports on Your Router/Firewall.

The only thing left to do is open a couple of ports in your router. This is different for every router/firewall. The ports you should redirect to your internal IP address are:

Protocol	Port Number	Protocol Type
HTTP	80	TCP/IP
SDX	52227	UDP
Modbus TCP/UDP	502	TCP/IP and or UDP

To get to the web pages on the unit, type http://yourname.yourselecteddomain. If the configurations of the router are correct, you should be able to access your I/O module.

Control

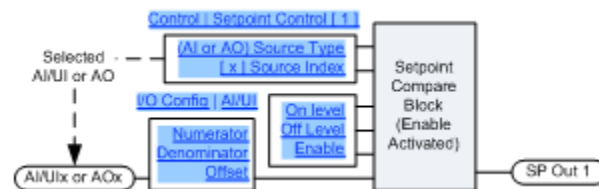
Overview

The Sprite, Ascent and Solaras products are built with essentially the same control engine according to each unit's I/O. The main purpose of the internal control logic is to make a duplex pump controller that works in several different system configurations. All configurations include alternation, as well as Pump Up or Pump Down operation modes:

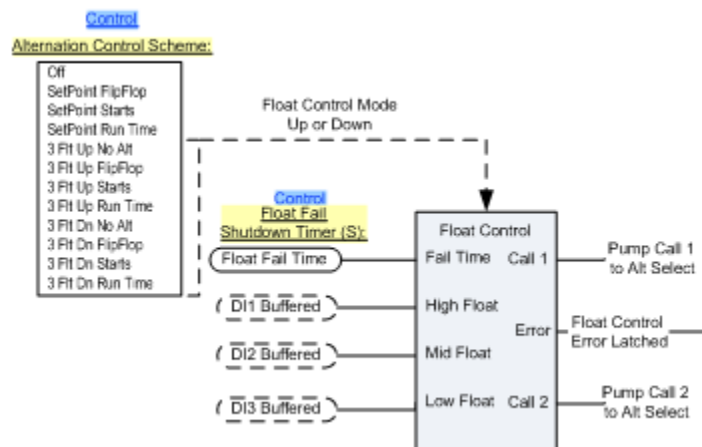
- Pump Control from a local Analog Input.
- Pump Control from a remote Analog Input or Analog Output (Holding Register).
- Pump Control using three Digital Inputs for float control.
- Duplex Pump Control discreetly controls two remote pumps at two difference sites from one tank.

The control mechanisms are broken up into 3 distinct sections that are interconnected in various configurations to accomplish a number control schemes. These blocks are:

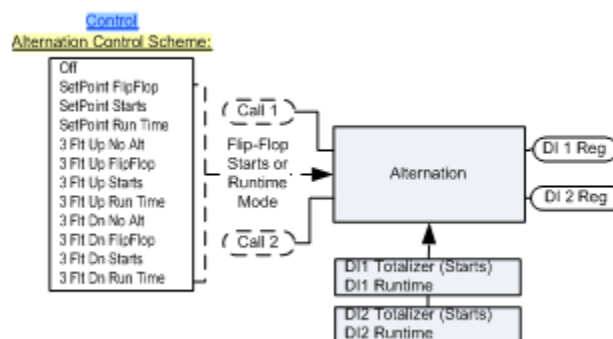
The Setpoint Compare Block:



The Float Control Block:



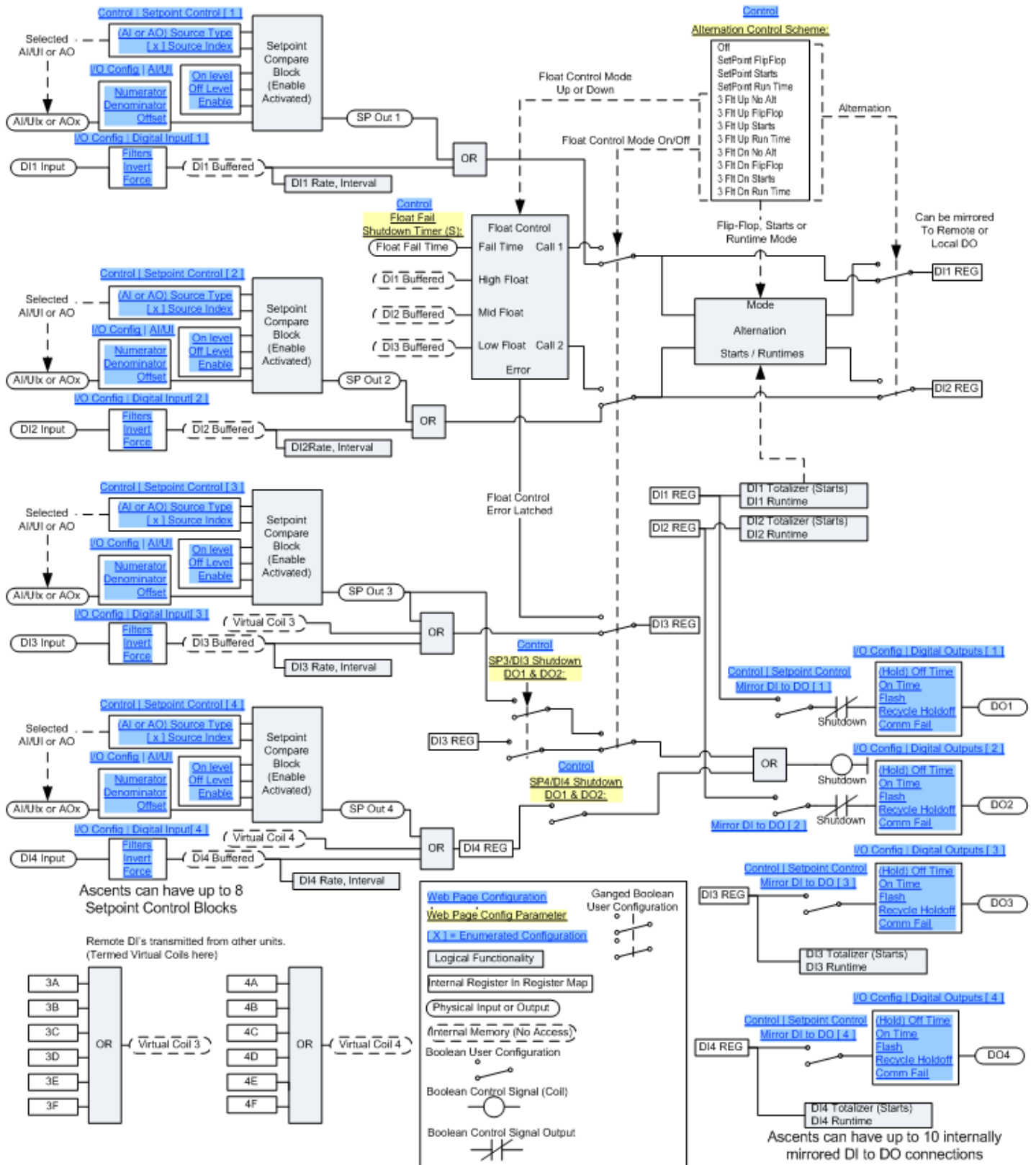
The Alternation Block:



Alternation Control Block

Ascent Combo I/O Module

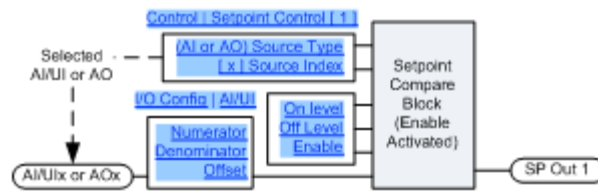
Each block in the control diagrams has a specific job in the control scheme and can be enabled or disabled according to the operating parameters desired for the pump control system:



General Control Logic Diagram

It should be noted here that the DI Registers are used for the “output” of the pump control logic. This is done to allow the use of Master Mode/Mirror Mode communications to send a pump call command to a compatible I/O module such as another Sprite, Ascent or Solaras.

The Setpoint Compare Block



This portion of the controller uses the *scaled* value of an Analog Input (or Universal Input depending on the source I/O module) or Analog Output compared to an [On level](#) setpoint and an [Off level](#) setpoint.

To enable setpoint control on an input, go to [Configuration | Control | Setpoint Control | Enable](#) [x] and check the enable box of the Setpoint block you want to use for setpoint control. For all I/O units, the number of Setpoint Compare Blocks matches the number of Analog/Universal Inputs.

Setpoint on and off configurations are located at [Control | Setpoint Control | On level](#) [#####] and [Control | Setpoint Control | Off level](#) [#####]

Setpoint Compare Block In a Pump Down System

With setpoint control on, if the [On level](#) is greater than the [Off level](#), and the input goes above the [On level](#) then the output of the Setpoint Compare Block (called SP Out) goes TRUE. SP Out is held TRUE until the input level is lower than the [Off level](#) setpoint, then SP Out goes FALSE. This is the appropriate configuration for a Pump Down controller.

Setpoint Compare Block In a Pump Up System

With the [On level](#) less than the [Off level](#) and the input goes below the [On level](#), SP Out goes TRUE. The SP Out is held true until the input level goes above the [Off level](#), then SP Out goes FALSE. This is the appropriate configuration for a Pump Up system.

There is one setpoint controller for each Analog/Universal Input by default. For a two pump system however, it is likely two setpoint control blocks need to be configured to control two output states (pumps) from the same Analog Input. This can be accomplished by setting the [Control | Setpoint Control | Source Channel](#) [x] 1 and 2 to a value of “1”. Then SP Out 1 and SP Out 2 are controlled by the same Analog/Universal Input or Analog Output depending on the [Control | Setpoint Control | Source Type](#) [x].

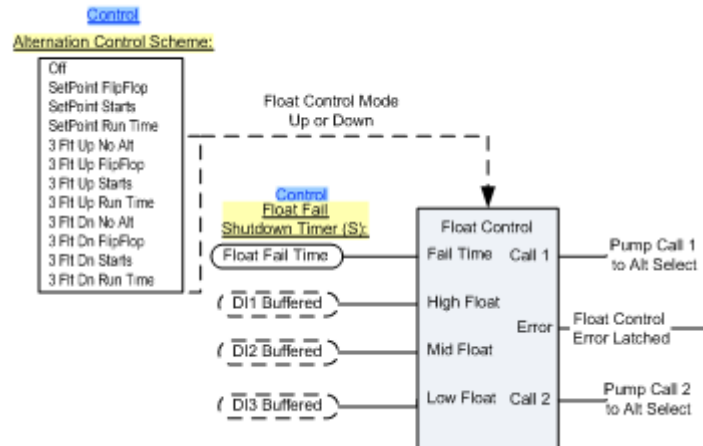
Setpoint Compare Block as a Local Shutdown

The SP Out register is fed either directly to the DI Registers or to the [Alternation Block](#) depending on the [Control | Alternation/Control Scheme](#): drop down selection.

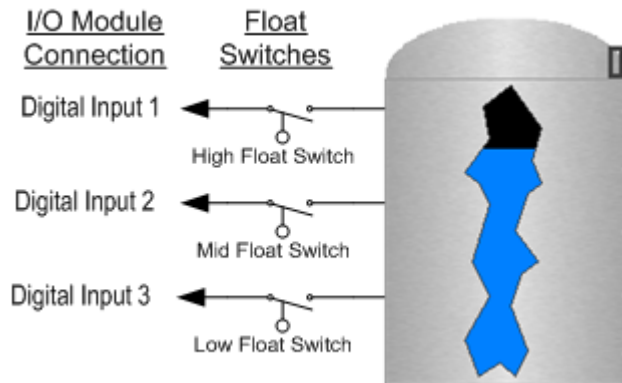
Setpoint Control Blocks may also be used as a local Digital Output Shutdown. This is done by checking the [Control | SP3/DI3 Shutdown DO1 & DO2](#): [x] or [Control | SP4/DI4 Shutdown DO1 & DO2](#): [x]. When checked the SP Out [#] register is used to shut down the Digital Outputs.

Since any Analog/Universal Input or Analog Output may be used to control the SP Out[#], this means that values allowed to come in any Local or Remote analog can shut down the local pumps. Some examples of this are: low suction, high pressure, high tank level, and low sump level.

The Float Control Block



This block allows a duplex pump controller to use a three float tank control scheme to control up to two pumps in either Pump Up or Pump Down configuration. In all float control configurations, the following wiring is used with Normally Open floats:



Float Control Digital Input Wiring

Digital Input 1 is always the High Float Switch, Digital Input 2 is always the Middle Float Switch and Digital Input 3 is always the Low Float Switch.

The Float Control Block is enabled when one of the "FLT" modes is chosen from the [Control](#) Alternation/Control Scheme: [] drop down selection. The modes that implement the Float Control Block are:

- 3 Flt Up No Alt
- 3 Flt Up FlipFlop
- 3 Flt Up Starts
- 3 Flt Up Run Time
- 3 Flt Dn No Alt
- 3 Flt Dn FlipFlop
- 3 Flt Dn Starts
- 3 Flt Dn Run Time

The "Up" and "Dn" specify the sequence in which input floats are used according to Pump Up and Pump Down applications respectively. The Alternation Schemes will be explained in the next section, [The Alternation Block](#).

The Float Control Block In a Pump Up System

Selecting one of the “Up” Modes allows the use of the Float Control Block in a tank filling or Pump Up application.

With the Low Float Closed (DI 3 TRUE) and the Mid Float opens (DI 2 goes FALSE), Call 1 will come TRUE and call the first pump (see [General Control Logic Diagram](#)).

Call 1 stays TRUE until the Mid Float and subsequently the High Float closes meaning the tank is full.

Should the Low Float (DI 3) come TRUE instead, then Call 2 will come TRUE and call the second pump.

Call 2 will then stay TRUE until the Mid Float closes.

Call 1 will stay TRUE until the High Float closes.

The Float Control Block In a Pump Down System

Selecting one of the “Down” Modes allows the use of the Float Control Block in a lift station/wet well or Pump Down application.

With the Low Float Closed (DI 3 TRUE) and the Mid Float Opens (DI 2 goes FALSE), Call 1 will come TRUE and call the first pump (see [General Control Logic Diagram](#)).

Call 1 stays TRUE until the Mid Float and subsequently the Low Float Opens meaning the tank/sump is empty.

Should the High Float (DI 1) come TRUE instead, then Call 2 will come TRUE and call the second pump.

Call 2 will then stay TRUE until the Mid Float opens.

Call 1 will stay TRUE until the Low Float opens.

The Float Control Block Fail States

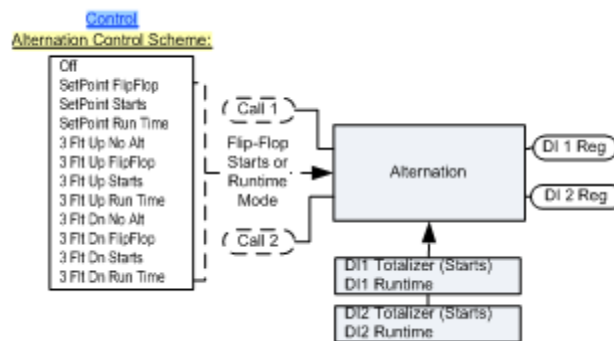
Should an impossible state arise, DI 3 Register is used to annunciate an error that latches until the system is power cycled or reset. The DI 3 Register can be read from an HMI, polled for over telemetry and also control the shutdown of Digital Outputs locally. The states that will latch an alarm are:

High Float	Mid Float	Low Float
TRUE	FALSE	FALSE
TRUE	TRUE	FALSE
FALSE	TRUE	FALSE
TRUE	FALSE	TRUE

The Float Control Fail Timer

The Float Control Fail timer is enabled for any of the Float Control Block modes. It can be set at [Control | Float Fail Timer \(S\): \[#####\]](#) and is in seconds. If Call 1 or Call 2 or both have been set to TRUE, if no float activity has been seen for this period of time, then the logic will shut down the calls and wait for the next float change. Setting the parameter to 0 will disable the Float Fail Timer logic.

The Alternation Block



There are four configurations for the Alternation Block:

Mode	Description
Off or No Alt	No Alternation
Alt	Always Alternate
Starts	Least number of positive DI Reg transitions
Run Time	Least amount of time DI Reg has been on.

Alt mode will always alternate DI Reg 1 and DI Reg 2 whenever the first Call is actuated from an off state.

Starts mode will alternate DI Reg 1 and DI Reg 2 based on which DI Reg has the least number of starts in the corresponding DI Totalizer register.

RunTime mode will alternate Call 1 and Call 2 based on which DI Register has the least amount of Runtime.

Off or No Alt mode will disable all alternation.

Web HMI

A Web interface is built into the I/O module for configuration, programming and control applications. Before you begin to access the system I/O and advanced configurations, you must get setup to allow TCP/IP access to the unit you wish to configure.

HMI Ethernet TCP/IP Configuration

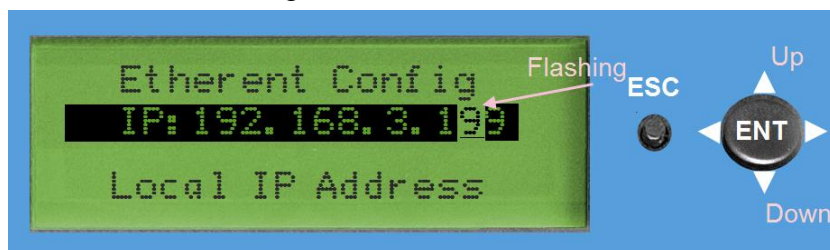
Press the down side of the joystick button until you see the following menu:



Click the button right to enter the Ethernet Config screen:

Using the up down keys, highlight the IP address and click ENT on the button to edit it.

Scroll to the digit you wish to edit--it will be inverted and flashing. Use the up and down arrows to change the digit. Move left and right to edit a different digit.



When you have the value desired, you may click ENT to finish.

If you want to get out without editing, then click the ESC button without clicking ENT.

To get back to the main menu, click ESC.

To get back to the startup screen, click ESC again.

After editing the IP address, you should be able to enter the web page at that IP address. With above example you would enter "http://192.168.3.199" in your browser's address bar. If this is successful, go to the [Getting Into the Web Browser](#) section.

Alternatively, you can also setup the TCP/IP parameters through the ICL I/O Configuration Tool software.

The I/O Config Toolbox

Download the current version of the I/O Configuration Toolbox for ICL Sprite, Solaras and Ascent here:

<http://www.iclinks.com/Support/IOConfig/DownloadIOConfigSW.html>

<http://www.iclinks.com/Support/IOConfig/DownloadIOConfigSW.html>

Unzip the file and run the Setup.exe to install the software.

At the end of the setup install process, run the I/O Config utility. You should see a screen like this:



To run this utility in the future, the shortcut is located at **Start | Programs | ICL Tools | IOConfig | IOConfig**. Connect the unit to be configured either directly with a crossover cable or through a network to a switch. Power the unit with a power supply that is 10Vdc to 30Vdc.

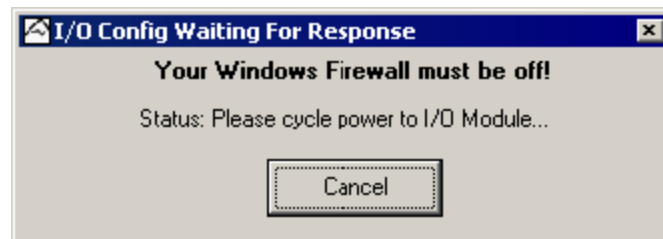
If it is connected correctly the green LAN light will light. If this does not happen, check that the cable is of the correct type.

Setting The TCP/IP Parameters



Click on the IP Configuration button.

In most cases you should see this window:



Your Windows Firewall (or any other firewall) should be off. If you are worried about your computer not being secure at this time, use an Ethernet crossover cable.

Cycle power on **ONLY** the module you wish to configure. Configuring more than one module at the same time from the I/O Configuration tool is not possible.

This dialog should close and you should see the following dialog (though your addresses will probably be different):

Shown here are is the actual IP address of the unit. You may change it to any IP address you wish.

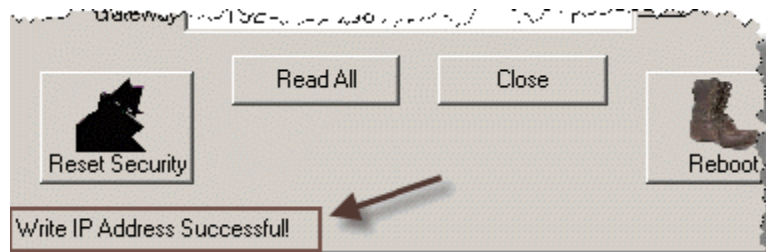
If you are on a stand alone network you may need to setup your PC with a compatible static IP.

If you are on a LAN and need a compatible address, make sure you do not configure the unit to an address already on the network.

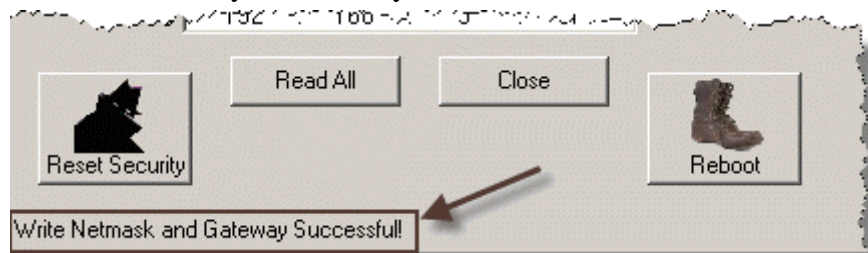
If you have an IT department, consult them before placing any unit on the local network.

Click the WRITE button beside the fields in question to save the parameters.

Writing the IP Address successfully will show this at the bottom of the screen:



Writing the Network Mask and Gateway successfully will show this at the bottom of the screen:



****Notice that you must have physical access to the unit to make these changes. Once configuration passwords are set from the web interface, the RESET SECURITY button is the only way to reset them should the passwords get lost. ****

The REBOOT button will place the unit back into "Run" mode with the new parameters. Click the REBOOT button and then the CLOSE button.

Ascent Combo I/O Module

Getting Into the Web Browser

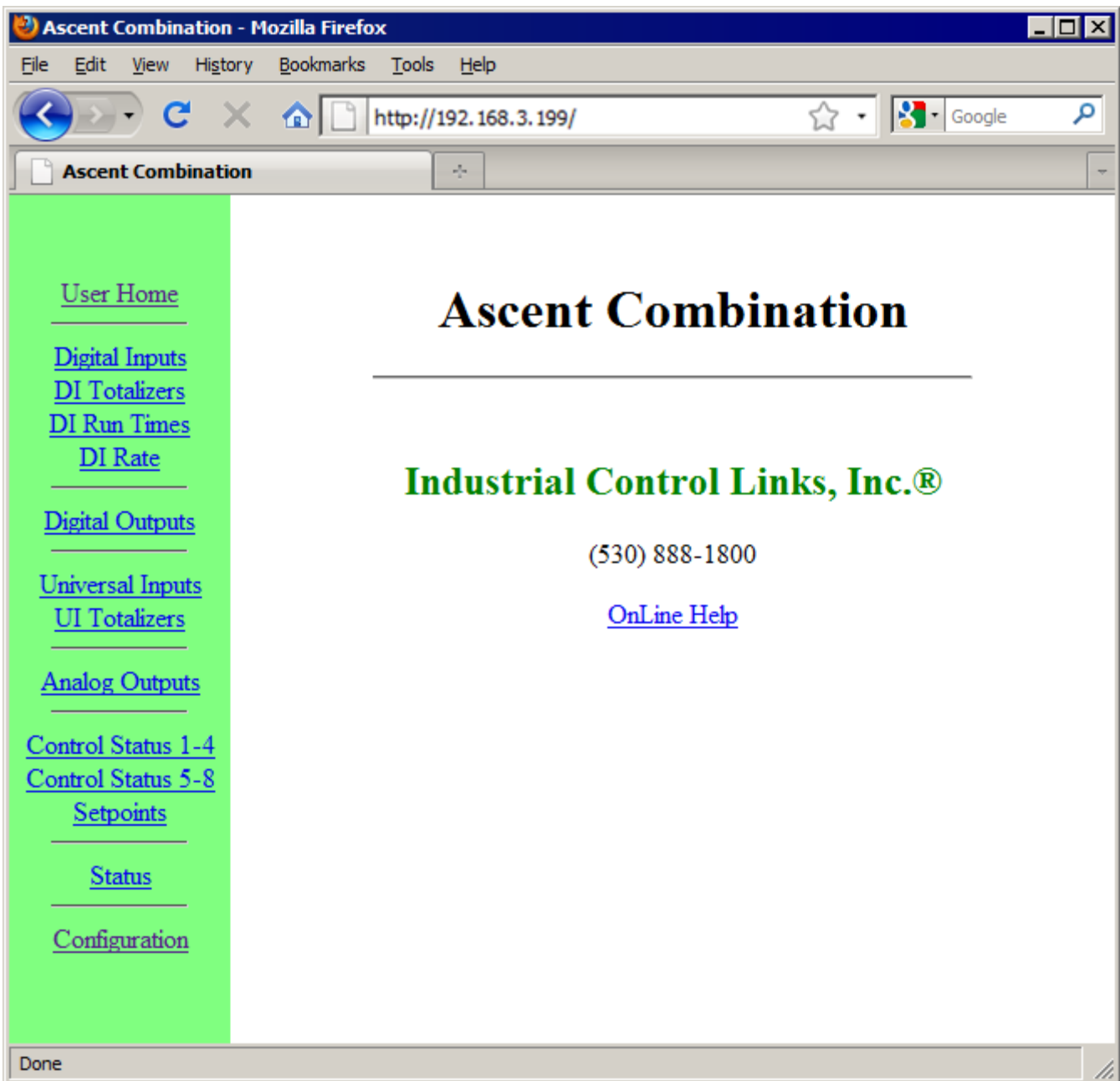
Most configuration and testing can be done from any web browser such as Internet Explorer or Mozilla Firefox. Once the IP address of an RTU is known and it is connected via Ethernet, any PC on the same logical network can log into the RTU and do a long list of operations.

To get into the web browser simply use the configured IP address in the address bar.

`http://<ip address>`

Using the same address that we have been configured for in this document, we use:

`http://192.168.3.199`



All the links on the left side of the page correspond to different I/O categories. Most are pretty self explanatory. Two screens here are pretty handy for troubleshooting systems however. For communications and internal status of the unit, use the [Status](#) page. For troubleshooting control and related configurations, use the [Control Status](#) page

The Status Page

The Status page gives a variety of information about the general status of the I/O module. Much of the data is communication and networking related.

Ascent Combination Status

Input Voltage: **12.5**

Serial #: **79234**

Comm Fail: **[Ethernet]**

Forcing: **[DI] [AI]**

Digi Radio RSSI(-dB): **-80**

Digi Radio RSSI [Last Msg] (-dB): **-80**

Response Code: **2002**

Comm Statistics

Mirror Mode Success %: **100**

Ethernet Xmits: **880**

Ethernet Rcvs: **880**

Serial Xmits: **1108**

Serial Rcvs: **1108**

Serial Last Id Rcvd: **20**

Radio Xmits: **668**

Radio Rcvs: **668**

Radio Last Id Rcvd: **3**

Input Voltage:

This is the power supply voltage being fed to the I/O Module.

Serial #:

Serial number on the case of the I/O Module.

Comm Fail:

If the **Comm Fail WatchDog (S)** is set on an interface (located in the [Communications | Radio, Serial](#) and [Ethernet](#) pages) and the time has elapsed since receiving a valid message on that interface, the Comm Fail status is displayed for that interface. The possible failures are [Radio], [Serial], [Ethernet] and [MirrorMaster]. A [MirrorMaster] Comm Fail happens if Master Mode is enabled (set to Radio, Serial or Ethernet) and the unit cannot contact the Destination over the configured interface. Comm Fail is asserted when the timeout has elapsed on all retries. This is configured in [Master Mode | Settings](#) page.

Forcing:

Shows if any I/O section has forcing currently applied to it. [DI], [DO], [AI], [AO]

Digi Radio RSSI(-dB):

This reading is taken from the RSSI analog output of the Digi/Maxstream radio. It shows the current level even is a message is not being received for this unit.

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Digi Radio RSSI [Last Msg](-dB):

This reading is taking from the RSSI analog output of the Digi/Maxstream radio. It shows the level last read when a message was received for this unit.

Response Code:

This field can display a variety of SDX, and DDNS errors. The error numbers are:

<u>Code Number</u>	<u>Code Type</u>	<u>Description</u>
1	SDX	Buffer overflow. We will put as many objects as we can fit into the buffer, but some objects may be missing.
2	SDX	Protocol is trying to process an unknown object type. The object will be skipped.
3	SDX	Object Data Type cannot be used / converted. The object data will be skipped.
4	SDX	The start Index is greater than the last register index. The object data will be skipped
5	SDX	Protocol is trying to read past the last register. The object data will be truncated and filled to the last register.
6	SDX	Protocol is trying to process an unknown command. The command will be skipped.
7	SDX	Protocol is trying to write to a Read Only Register
8	SDX	Slave needs to be configured for MirrorMode. This is normal for a MirrorMode session
9	SDX	There are too many masters trying to connect to this slave. Eight is the Maximum (at this time).
102	SDX_R	Remote is trying to process an unknown object type. The object will be skipped.
104	SDX_R	Remote Error--the start Index is greater than the last register index. The object data will be skipped
105	SDX_R	Remote is trying to write past the last register. The object data will be truncated and filled to the last register.
1000	Dynamic DNS	Service has been successfully Updated.
2000	Dynamic DNS	Service was aborted because the DNS Server IP is 0.0.0.0 or the Dynamic DNS Server name is blank
2001	Dynamic DNS	Service got a Bad response from the Dynamic DNS Server
2002	Dynamic DNS	Service was aborted because of a bad configuration or timeout
2100	DNS	Bad response from DNS Server
2200	DHCP	Did not finish. We will retry again

Mirror Mode Success%:

Of the last 32 message attempted, this is the percentage of those messages that received a valid response. This is the short-term health of the Master/Mirror mode communication link.

Ethernet Xmits:

Number of valid protocol packets transmitted over the Ethernet port. This is a retained number. Applies to Modbus TCP/IP, Modbus UDP and SDX/MirrorMode protocols.

Ethernet Rcvs:

Number of valid protocol packets received over the Ethernet port. This is a retained number. Applies to Modbus TCP/IP, Modbus UDP and SDX/MirrorMode protocols.

Serial Xmits:

Number of valid protocol packets transmitted over the Serial port. This is a retained number. Applies to Modbus RTU, DF1, Bricknet and SDX/MirrorMode protocols.

Serial Rcvs:

Number of valid protocol packets received over the Serial port. This is a retained number. Applies to Modbus RTU, DF1, Bricknet and SDX/MirrorMode protocols.

Serial Last Id Rcvd:

The source address of the last valid received message on the Serial port from a peer to peer protocol. This is a retained number. Applies to Bricknet and SDX protocols.

Radio Xmits:

Number of valid protocol packets transmitted over the Radio port. This is a retained number. Applies to Modbus RTU, DF1, Bricknet and SDX/MirrorMode protocols.

Radio Rcvs:

Number of valid protocol packets received over the Radio port. This is a retained number. Applies to Modbus RTU, DF1, Bricknet and SDX/MirrorMode protocols.

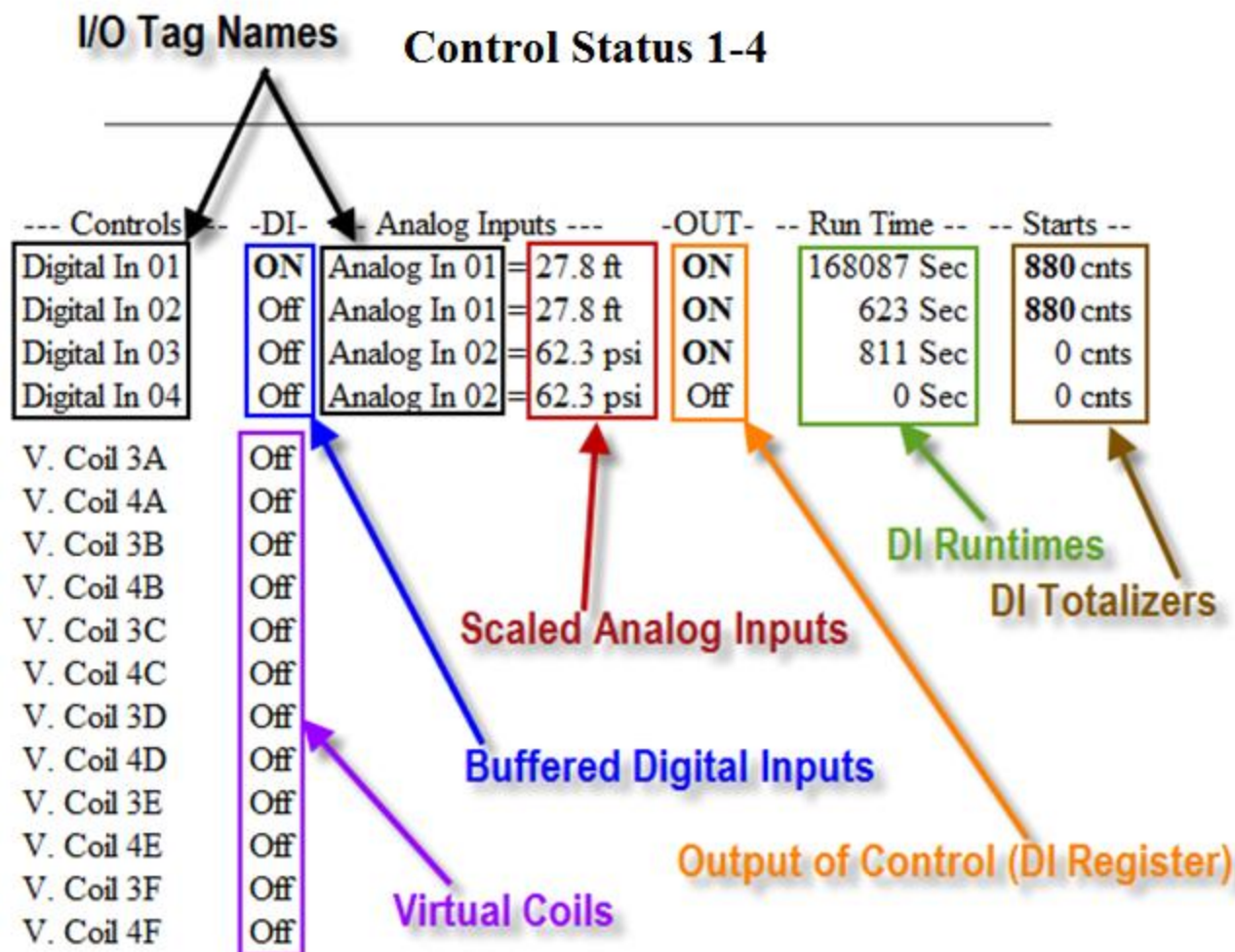
Radio Last Id Rcvd:

The source address of the last valid received message on the Serial port from a peer to peer protocol. This is a retained number. Applies to Bricknet and SDX protocols.

The Control Status Page

This page is activated when either a Setpoint Control Block is enabled or a Float Control Mode is selected. Click on the [Control Status 1-4](#) link or the [Control Status 5-8](#) on the left hand side to access the page.

Ascent Combination



I/O Tag Names

Names may be changed to describe the input's job or type. "Pump 1 Run", "High Float", "Tank Level" are some examples of Tag Name that can help understand the data being displayed. See the [Tag Name](#) parameter under each of I/O configuration sections.

Buffered Digital Inputs (-DI- Column)

The -DI- Column shows the Dix Buffered state. If the Digital Input is forced, this field will show the forced value. This value also reflects the filters and/or inverted value of the Digital Input.

Scaled Analog Inputs (-- Analog Inputs -- Column)

This is the Scaled and Formatted version of the Analog Input. If the Analog Input is forced then the forced value is shown.

Output of Control (-OUT- Column)

This column displays the end result of all Control configurations. It is the direct reflection of the Digital Input Register before it is sent to a local or remote Digital Output control point.

DI Runtimes (--Run Time—Column)

This column displays Digital Input Runtimes for verifying Alternation based on pump run time.

DI Totalizers (--Run Time—Column)

Ascent Combo I/O Module

This column displays Digital Input Totalizers for verifying Alternation based on number of pump starts.
Virtual Coils

This column displays the state of virtual coils that may be sent to the unit from remote Digital Inputs on other devices.

Configuring From the Web Browser

Click on the [Configuration](#) link in the User Home page to get into the configuration pages.

Ascent Combination - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://192.168.3.199/

Ascent Combination

User Home

I/O Config

Communication

HMI Config

Master Mode

Control

Misc

Digital Inputs

Digital Outputs

Universal Inputs

Analog Outputs

I/O Config

UI Totalizer Gate Time(S): 60

DI Rate Gate Time(S): 1

DI Stretch (x100mS): 5

DO Flash Rate (x10mS): 100

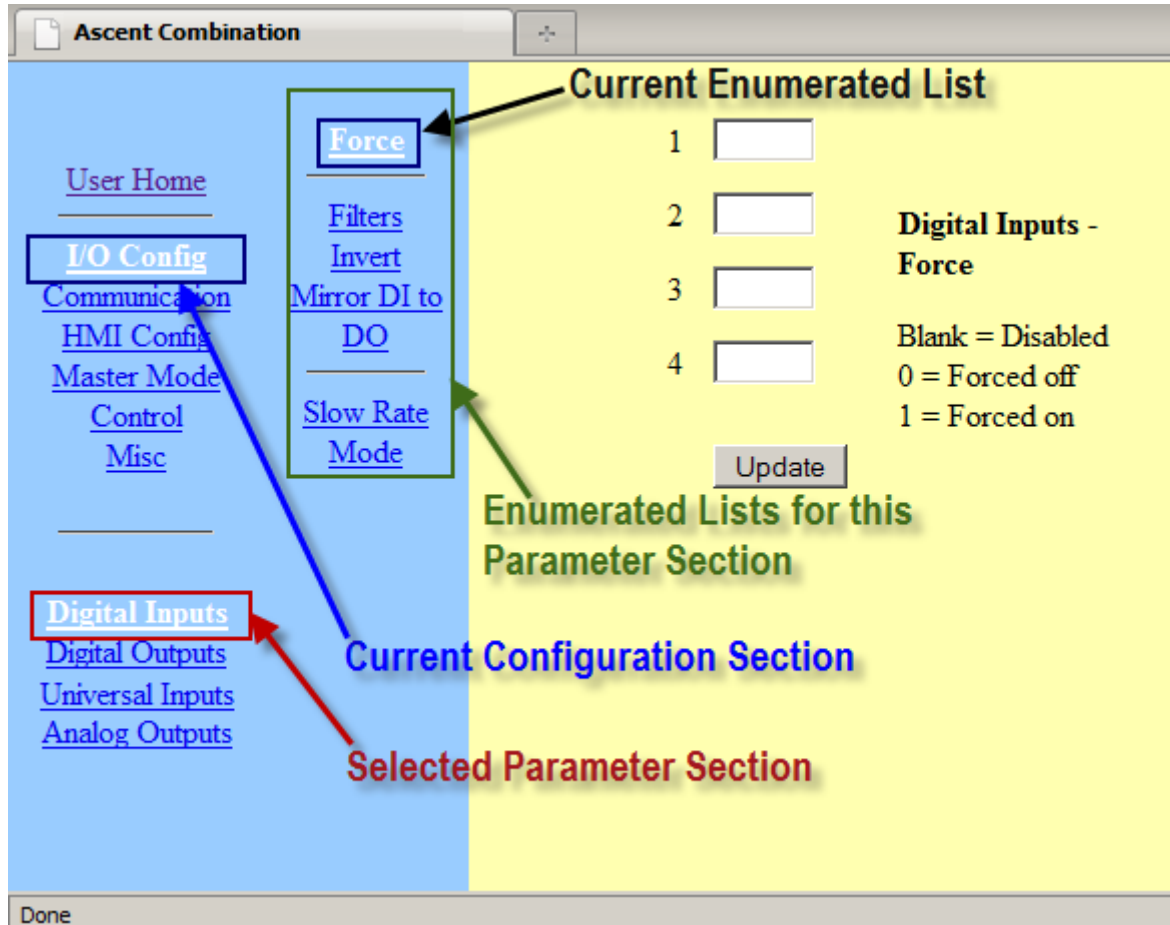
Temperature in C : ☐

Update

Done

Configuration Navigation

When you first go into [Configuration](#) mode, the first screen shows the first link on the left hand side after the [User Home](#). [User Home](#) gets you back to the regular display pages. From there are three navigations sections on the left hand frame of the web page. The top two sections are fixed, while the bottom parameter section changes depending on the configuration section clicked.



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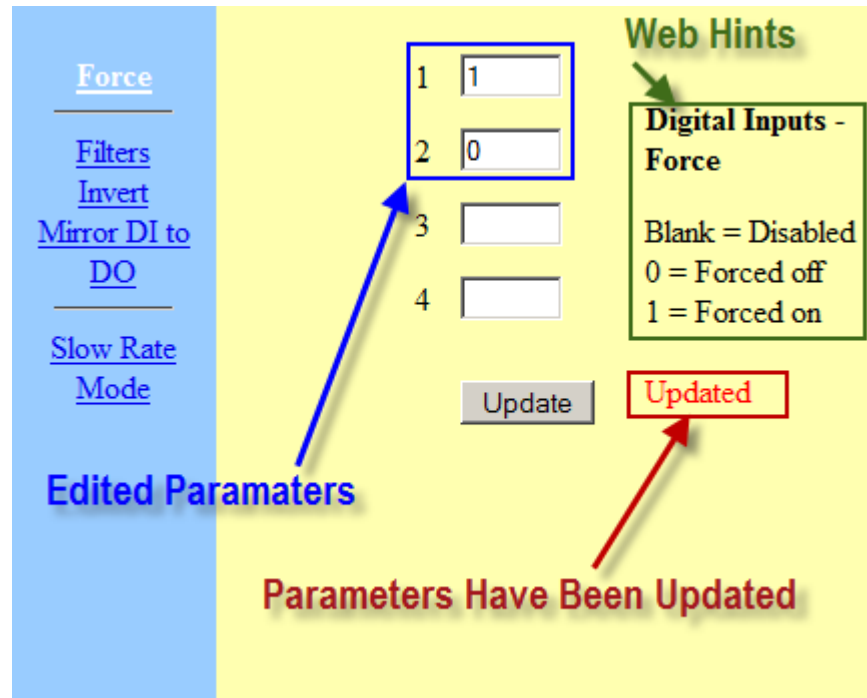
As you change configuration sections in the left hand side, the parameter menu on the bottom changes in context. Click on the links in the bottom menu to navigate the desired configuration item.

The screenshot displays the 'I/O Config' web interface. On the left is a blue sidebar with navigation links: 'User Home', 'I/O Config' (highlighted), 'Communication', 'HMI Config', 'Master Mode', 'Control', and 'Misc'. Below these are links for 'Digital Inputs', 'Digital Outputs', 'Universal Inputs', and 'Analog Outputs'. The main content area is yellow and titled 'I/O Config'. It features a table with four rows of parameters: 'AI Totalizer Gate Time(S):' with value '0', 'DI Rate Gate Time(S):' with value '1', 'DI Stretch (x100mS):' with value '5', and 'DO Flash Rate (x10mS):' with value '100'. To the right of the table is a red-bordered 'Data Entry Area' containing the input fields. Below the table is a grey 'Update' button. Annotations include: a black arrow pointing to the parameter names, a blue arrow pointing to the 'I/O Config' link in the sidebar, a green arrow pointing to the 'Digital Outputs' link, and a grey arrow pointing to the 'Update' button. Text labels with arrows identify the 'Parameters Names', 'Data Entry Area', 'Configuration Sections' (noting that the white link is the current page), and 'Parameter Sections' (noting that it changes with configuration sections).

Parameters Names	Data Entry Area
AI Totalizer Gate Time(S):	0
DI Rate Gate Time(S):	1
DI Stretch (x100mS):	5
DO Flash Rate (x10mS):	100

Update

A second frame comes up on the left hand side for I/O based and other enumerated configurations. This second frame applies to the bottom menu selected. Clicking a parameter in the second frame gives an enumerated I/O interface for each I/O point.



Most screens have an **Update** button on them. Clicking the **Update** button will program the unit with the current values on that page and show the **Updated** status at the bottom of the page.

In the case of a numeric entry field, hitting enter while the cursor is blinking within the edit box is the same as clicking the **Update** button.

Web Hints are available on the page to help you with entry values, formulas and other helpful hints and also include the current location. In the above examples, we always know where we are by what links are shown in white in the left hand frames.

The following configuration sections in this manual use this nomenclature:

[Configuration Section | ...](#)

[Configuration Link](#)

[Link To Enumerated I/O Page](#) [(parameter type)]

[Configuration Parameter](#) [(parameter type)]

[(parameter type)] = :

[#####] = Parameter Numeric Entry Field.

[#] = Numeric Parameter Boolean Value: 1=TRUE, 0=FALSE, Blank = Disabled

[x] = Parameter Checkbox

[s(size)] = Text Input with number of characters possible

[dd(x)] = Drop Down selection where x is the number of options.

[Link 1](#) | **[Link 2](#) | **[Link 3](#)** = Navigation Path (Click on **[Link 1](#)** then **[Link 2](#)** then **[Link 3](#)**)**

[Link Section | ...](#) = Section link to more links and parameter pages

I/O Configuration Section

Click on the **[I/O Config](#)** link. The sections are broken down into I/O types. **[Digital Inputs](#)**, **[Digital Outputs](#)**, **[Universal or Analog Inputs](#)**, and **[Analog Outputs](#)**.

[I/O Config | ...](#)

UI/AI Totalizer Gate Time(S): [#####]

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Period at which Analog Input Totalizers are accumulated and updated from Analog Input's or Universal Input's scaled value.

0-65535 seconds

DI Rate Gate Time(S): [#####]

Period at which the Digital Input Rate is sampled. In DI Slow Rate Mode, this parameter is not used.

0-65535 seconds

DI Stretch (x100mS): [#####]

When a Digital Input goes from FALSE to TRUE, a TRUE will be held for this period of time in the DI Stretch register (see Modbus Map Status Register section).

0-65535 x100mS increments (0 to 6553 seconds).

DO Flash Rate (x10mS): [#####]

If Digital Output Flashing is enabled on any Digital Output, this parameter controls the rate.

0-65535 x10mS (0 to 655 seconds)

Temperature In C: [x]

Changes all temperature calculations and readings from Fahrenheit to Celsius.

Unchecked = Fahrenheit, Checked = Celsius

Digital Inputs | ...

Force[#]

Forces Digital Inputs to a particular state overriding the physical Digital Input.
Blank = normal, 0 = Forced off, 1 = Forced on.

Filters[x]

Delays the change of state of a Digital Input from being recognized until the state has been held for this time.
0 = disabled, 1 – 65535mS

Invert[x]

Inverts the state of the incoming Digital Input signal
Unchecked = Normal, Checked = Invert

Link Local DI to DO[x]

Takes the state of the Local Digital Input register and writes it to the corresponding Digital Output register
Unchecked = Normal, Checked = Link

Slow Rate Mode[x]

Use interval math for calculating pulse rates but using the time between pulses to calculate the rate.
Best for use with pulses that are faster than once a minute but slower than once a second.
Unchecked = Fast Pulse Rates, Checked = Slow Pulse (interval) Rates.

Digital Outputs | ...

Force [#]

Forces Digital Outputs to a particular state overriding the Digital Output register value.
Blank = normal, 0 = Forced off, 1 = Forced on.

Link Local DI to DO[x]

Takes the state of the Local Digital Input register and writes it to the corresponding Digital Output register
Unchecked = Normal, Checked = Link

On Time [#####]

If used with no (Hold) Off time, this function provides a one shot of the time specified when the Digital Output register is set to TRUE.
If used in conjunction with the (Hold) Off Time ((Hold) Off Time set to 0), the Digital Output register when turned on will cycle the output on for the On Time then off for the (Hold) Off Time then repeat. Using this functionality, it is possible for the user to control the DO as a Pulse Width Modulated (PWM) output. Should not be used in conjunction with the Flash enable.
0= disabled, 1 - 65535 x10mS (0 to 655 seconds)

(Hold) Off Time [#####]

If used in conjunction with the On Time, the Digital Output register when turned on will cycle the output on for the On Time then off for the (Hold) Off Time then repeat. Using this functionality, it is possible for the user to control the DO as a Pulse Width Modulated (PWM) output. Should not be used in conjunction with the Flash enable.
If used with no On Time specified(On Time set to 0), this function provides a delay of the time specified when the Digital Output register is set to TRUE and when the physical Digital Output is allowed to turn on. In this mode it can be thought of as an on-delay timer for that Digital Output.
0 = disabled, 1 - 65535 x10mS (0 to 655 seconds)

Flash [x]

With Flashing enabled on a Digital Output, when the Digital Output register is set to TRUE, the physical output will cycle at the specified DO Flash Rate.
Unchecked = no flash, Checked=flash when DO register is set to TRUE.

Recycle Holdoff [#####]

If this value is set, when the DO Register goes from TRUE to FALSE, this timer starts running and inhibits the physical outputs from turning on until the timer elapses. Once the timer has elapsed, the DO register may be set to TRUE and the physical output will turn on immediately when called.
0 = disabled, 1-65535 seconds

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Comm Fail [#]

When a communication failure is detected over Ethernet, Serial or Radio, this configuration defines what state the Digital Output Register is left in.

Blank = disabled, 0 turns OFF DO after a Comm Fail, 1 turns ON the DO after a Comm Fail.

Universal Inputs | ...

Force [#####]

Forces the UI Prescaled input to a number overriding the physical input.

Blank = normal, -32767 to 32768 = forced.

Mode [#]

Selects one of the following modes.

Sensor	Mode Number	Range (or Degrees C x 10)	Degrees F x 10
Milliamps 0 to 20	0	0 to 20000	
Milliamps 4 to 20	1	4000 to 20000	
Voltage 0 to 2.0 VDC	2	0 to 20000	
Millivolt +/-250	3	-25000 to 25000	
Millivolt +/-100	4	-10000 to 10000	
Millivolt 0 to 250	5	0 to 25000	
Ohms 0 to 30K	6	0 to 30000	
Ohms 0 to 300K	7	0 to 30000	
Thermo Couple J	8	-2072 to 12029	-3409 to 21972
Thermo Couple K	9	-2160 to 13754	-3568 to 25077
Thermo Couple T	10	-2130 to 4033	-3514 to 7579
Thermo Couple E	11	-2071 to 10009	-3407 to 18336
Thermo Couple R	12	-933 to 17930	-1359 to 32594
Thermo Couple S	13	-858 to 17825	-1224 to 32405
Thermo Couple B	14	2455 to 18393	4739 to 33427
Thermo Couple N	15	-2240 to 13035	-3712 to 23783
RTD 10 3 wire	16	-3200 to 5000	-5440 to 9320
RTD 10 2 wire	17	-3200 to 5000	-5440 to 9320
RTD 100-385 3 wire	18	-2469 to 8894	-4124 to 16329
RTD 100-385 2 wire	19	-2469 to 8894	-4124 to 16329
RTD 100-392 3 wire	20	-2427 to 8700	-4048 to 15980
RTD 100-392 2 wire	21	-2427 to 8700	-4048 to 15980
RTD 1K 3 wire	22	-2469 to 8894	-4124 to 16329
RTD 1K 2 wire	23	-2469 to 8894	-4124 to 16329
Thermistor 10K type II	24	-587 to 2286	-736 to 4434
Thermistor 10K type III	25	-659 to 2485	-866 to 4793
Pulse Rate Input	100	0 to 20000	

Averaging [#####]

This parameter sets the degree of oversampling in a boxcar average.

0 =Averaging disabled, 1 = 2 samples, 2 = 4 samples, 3 = 8 samples, 4 = 16 samples, 5 = 32 samples

Link Local UI to AO [x]

Takes the local Analog Input register and writes it to the local Analog Output register.

Universal Input Scaling

These parameters work together to perform a linear scaling.

Scaled = (Prescaled * [Scaling Numerator](#)) / [Scaling Divisor](#)) + [Scaling Offset](#))

Scaling Numerator [#####]

Usually configured for engineering units or engineering units x 10.

Scaling Divisor [#####]

Usually configured for the full range of the UI depending on mode. 20000 for 0-20mA, 16000 for 4-20mA

Scaling Offset [#####]

Configured for any offset in engineering units.

[Analog Outputs | ...](#)

[Force \[#####\]](#)

Forces the Post-scaled Analog Output to a value.
Blank = normal, -32768 - 32767 = forced.

[Mode \[#\]](#)

Selects either 0 =) 0 -20 mA (0-20000) or 1 =) 4- 20mA (0-16000).

[Comm Fail \[#####\]](#)

When a communication failure is detected over either Ethernet, Serial or Radio, this configuration defines what state the Analog Output Register is left in.
Blank = disabled, .

Analog Output Scaling

AO Display = (AO Register* [Scaling Numerator](#) / [Scaling Divisor](#).) + [Scaling Offset](#)

Placing a 1 in the numerator, 1 in the divisor and 0 in the offset (this is the default) applies no scaling.

[Scaling Numerator \[#####\]](#)

Usually configured for engineering units or engineering units x 10.

[Scaling Divisor \[#####\]](#)

Usually configured for the full range of the AI depending on mode. 20000 for 0-20mA, 16000 for 4-20mA

[Scaling Offset \[#####\]](#)

Configured for any offset in engineering units.

Communications

[Communications | ...](#)

Click on the [Communications](#) link. The sections are broken down into interface sections: [Ethernet](#), [Ethernet Ports](#), [DDNS/DHCP](#), [Serial](#), [Radio](#), [Radio Diagnostics](#), and [Bridge](#) .

[SDX Unit ID: \[#####\]](#)

Secure Data Exchange network address. This parameter is common for all SDX interfaces (Ethernet, Serial and Radio).

[Message Size Limit: \[###\]](#)

Secure Data Exchange maximum message size limit. 262 bytes is default. The minimum value is 208 bytes. The maximum is 518 bytes. This is useful if a packetizing radio or modem has small transmit or receive buffers.

[Ethernet](#)

[Local IP: \[xxx.xxx.xxx.xxx\]](#)

Ethernet TCP/IP and UDP address for module. See Setting the TCP/IP Parameters in this section.

[Subnet Mask: \[xxx.xxx.xxx.xxx\]](#)

This value is typically 255.255.255.0 for class C networks.

[Gateway: \[xxx.xxx.xxx.xxx\]](#)

IP address of firewall or router to get to outside network. Required for applications using Master Mode over Ethernet that need to go out over the Internet or an outside IP network.

[DHCP Enable: \[x\]](#)

Use Dynamic Host Control Protocol to get an IP address from a local DHCP server or router. This overrides the Local IP parameter only if the DHCP process is successful. The new IP address will show up in the Local IP field.

[Modbus Addr: \[#####\]](#)

Modbus TCP Unit ID (slave address). This address only applies to the Ethernet port.
1-255

[Comm Fail Watchdog \(S\): \[#####\]](#)

If the unit has not received a telemetry message from Modbus TCP, Modbus UDP or SDX over Ethernet, then a communication failure is asserted. This applies to DO and AO Comm Fail configurations.
0 = disabled, 1 – 65535 seconds

Ascent Combo I/O Module

Ethernet Ports

Modbus Port: [#####]

TCP and UDP port number for Modbus TCP and Modbus UDP protocols. This is also the port number if using Protocol Bridging from Modbus TCP/UDP to Modbus RTU on serial or radio interfaces.

Default = 502, 1 - 65535

SDX Port: [#####]

Secure Data Exchange UDP port number

Default = 52227, 1 - 65535

HTTP Port: [#####]

Web server port number.

Default = 80, 1 - 65535

Bridge Port: [#####]

If using Pass Thru Mode bridging on a radio or serial port, this is the UDP port number to use for serial port emulation on a PC or other UDP device.

Default = 52226, 1- 65535

DDNS/DHCP

Configuration of Dynamic Domain Name Server interface as well as the Domain Host Control Protocol.

Default = 52226, 1- 65535

DDNS Enable: [x]

Turns on DDNS message to the configured server.

Hostname: [s(63)]

More data later XXX

Username: [s(63)]

Account user name for Dynamic DNS server. Usually the username is an email address.

Password: [s(23)]

Account password.

Server: [s(63)]

Server to log into. Must have DNS server configured in the Ethernet settings page above.

Serial

(Sprites and Solaras with Radio Option and Ascent)

Protocols: [dd(3)]

Dropdown selection of available protocols on the serial port. The purpose of this is to allow the shutting down of less secure protocols in favor of SDX as well as selecting either Modbus RTU Slave or DF1 Slave as these protocols cannot coexist on the same serial port.

SDX+MB+BN = Secure Data Exchange, Modbus RTU Slave and Bricknet.

SDX+DF1+BN = Secure Data Exchange, DF1 Slave and Bricknet.

SDX Only = Secure Data Exchange only.

Baudrate: [dd(8)]

Dropdown selection of available baud rates for the serial port:

1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

Modbus/DF1/BN Addr: [#####]

Modbus RTU Slave, DF1 Slave and Bricknet Unit Address. This is for the serial port only.

SDX Unit ID: [#####]

Secure Data Exchange network address. This parameter is common for all SDX interfaces (Ethernet, Serial and Radio).

1 - 65535

TxEn Delay (x1 mS): [#####]

On the serial port option, the RTS (Request To Send) RS-232 signal is available to use as a Push To Talk (PTT) for an external radio or modem device. This parameter control how long RTS is asserted before sending data.

Comm Fail Watchdog (S): [#####]

When acting as an SDX, Bricknet, DF1 Slave or Modbus RTU Slave device, if the unit has not received a telemetry message any one of this protocols, then a communication failure is asserted. This applies to DO and AO Comm Fail configurations.

0 = disabled, 1 – 65535 seconds

In Address: [#####]

Modbus RTU only. Start of the block of Modbus addresses to be translated up to the Out Address to utilize the serial port as a Modbus RTU store and forward (repeater) device. (See [Modbus Store and Forward](#) section)

Out Address: [#####]

Modbus RTU only. Start of the block of Modbus addresses to be used for translated up from the In Address to utilize the serial port as a Modbus RTU store and forward (repeater) device. (See [Modbus Store and Forward](#) section)

Block Size: [#####]

Modbus RTU only. Number of contiguous addreeses to be used for translated up from the In Address to the Out Address offset to utilize the serial port as a Modbus RTU store and forward (repeater) device. (See [Modbus Store and Forward](#) section)

Radio

(ICL Internal Radio Option only)

Protocols: [dd(3)]

Dropdown selection of available protocols on the serial port. The purpose of this is to allow the shutting down of less secure protocols in favor of SDX as well as selecting either Modbus RTU Slave or DF1 Slave as these protocols cannot coexist on the same serial port.

SDX+MB+BN = Secure Data Exchange, Modbus RTU Slave and Bricknet.

SDX+DF1+BN = Secure Data Exchange, DF1 Slave and Bricknet.

SDX Only = Secure Data Exchange only.

Baudrate: [dd(8)]

Dropdown selection of available baud rates for the radio port:

1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

This must match the configured port baud rate of the installed radio option.

Modbus/DF1/BN Addr: [#####]

Modbus RTU Slave, DF1 Slave and Bricknet Unit Address. This is for the serial port only.

Comm Fail Watchdog (S): [#####]

When acting as an SDX, Bricknet, DF1 Slave or Modbus RTU Slave device, if the unit has not received a telemetry message any one of this protocols, then a communication failure is asserted. This applies to DO and AO Comm Fail configurations.

0 = disabled, 1 – 65535 seconds

In Address: [#####]

Modbus RTU only. Start of the block of Modbus addresses to be translated up to the Out Address to utilize the radio port as a Modbus RTU store and forward (repeater) device. (See [Modbus Store and Forward](#) section)

Out Address: [#####]

Modbus RTU only. Start of the block of Modbus addresses to be used for translated up from the In Address to utilize the radio port as a Modbus RTU store and forward (repeater) device. (See [Modbus Store and Forward](#) section)

Block Size: [#####]

Modbus RTU only. Number of contiguous addreeses to be used for translated up from the In Address to the Out Address offset to utilize the radio port as a Modbus RTU store and forward (repeater) device. (See [Modbus Store and Forward](#) section)

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Radio Diagnostics

Diagnostic Mode: [x]

Redirects Telnet port (TCP/IP port 23) to the internal radio's diagnostic port. From there, and command or configuration the radio expects can be entered from a Telnet terminal emulation program.

Port Baud Rate: [dd(8)]

Dropdown selection of available baud rates for the radio port:

1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

This must match the configured port baud rate of the installed radio option. This is usually setup to 115200 at the factory and should not be changed unless greater sensitivity is required from the radio (Digi/Maxstream only).

RSSI -110dB / 9600: [x]

With the Digi (Maxstream) internal radio option, changing the over-the-air baudrate to 9600 increases the sensitivity of the receiver. If this configuration is chosen, then this box must be checked to rescale the internal RSSI sensor for accuracy.

Bridge

Eth<->Serial: [dd(3)]

Units with a serial port have the advantage of being able to pass data from the Ethernet port to the serial port and back again allowing the I/O module to act as an Ethernet to serial bridge. There are two modes, Pass Thru and Protocol. Pass Thru very simply passes any UDP message received on the Bridge Port (see below) and strips off the UDP portion of the message and redirects the content of the packet out the serial port. Any responses are redirected back to the originating host that sent the UDP message in the first place. If an unsolicited packet is received on the serial port first, (and the packet timeout has elapsed) then the packet is redirected to the UDP Bridge Port and the Destination IP address.

Protocol Mode can utilize Modbus TCP, Modbus UDP or SDX UDP as an Ethernet to Serial translator. If the Unit ID of any of the above protocols is different than the local unit's ID, then the message is converted to a serial message (Modbus RTU or SDX serial depending on which protocol is received) and sent out the local port. If the Unit ID is for the local unit, then the unit simply responds with no redirection. See [Bridging](#) section in the Operations section of this manual.

Off, PassThru, Protocol

Eth<->Radio: [dd(3)]

Units with a radio option have the advantage of being able to pass data from the Ethernet port to the radio and back again allowing the I/O module to act as an Ethernet to radio bridge. There are two modes, Pass Thru and Protocol. Pass Thru very simply passes any UDP message received on the Bridge Port (see below) and strips off the UDP portion of the message and redirects the content of the packet out the radio. Any responses are redirected back to the originating host that sent the UDP message in the first place. If an unsolicited packet is received on the radio first, (and the packet timeout has elapsed) then the packet is redirected to the UDP Bridge Port and the Destination IP address.

Protocol Mode can utilize Modbus TCP, Modbus UDP or SDX UDP as an Ethernet to Radio translator. If the unit ID of any of the above protocols is different than the local unit's ID, then the message is converted to a serial message (Modbus RTU or SDX serial depending on which protocol is received) and sent out the local port. If the Unit ID is for the local unit, then the unit simply responds with no redirection. See [Bridging](#) section in the Operations section of this manual.

Off, PassThru, Protocol

Serial<->Radio: [dd(3)]

Any data at the correct baudrate will be passed from the radio to the serial port and from the serial port to the radio essentially ganging the two interfaces together as one multidrop network. This can also utilize the RS-485 port on the serial port to talk to more than one slave from the radio port. In this mode, all addresses on the radio and the serial/RS-485 link cannot overlap.

Packet Timeout (x1 ms): [#####]

When using either Protocol or Pass Thru bridging, if a message is received from an IP device on the Ethernet port and redirected, the response information is kept for the serial response to get redirected back to the initiating host. When the time elapses, the information is flushed and the unit will stand by waiting for the next bridgeable message.

Pass Thru Mode Respond to Bridge Port: [x]

When using Pass Thru mode, some UDP serial port emulators expect Ethernet devices to send responses back to the UDP port that initiated the message. If your UDP serial port emulation software does not work initially then try checking this box. It may start working if all other configurations are correct (Destination IP, port, and Host IP on the software).

ICL has tested this option with emulation software from www.eterlogic.com.

Bridge Port: [#####]

If using Pass Thru Mode bridging on a radio or serial port, this is the UDP port number to use for serial port emulation on a PC or other UDP device.

Default = 52226, 1- 65535

HMI Configuration

[HMI Config | ...](#)

Unit Name: [s(32)]

This name is displayed on both the User Home page of the I/O module and on the Remote HMI for Viewpoint Express.

User Page Refresh(S): [#####]

Speed in seconds which the User Web page I/O page will update.

User Home Page: [s(512)]

Sets up the front end webpage. 512 characters of any html code can go in this space. Links here should be in reference to the browser used (graphics from other web sites may be used but must be available to the browser viewing the page).

[Digital Inputs | ...](#)

HMI Digital Input configuration section.

[Tag Names \[s\(14\)\]](#)

Display names for each of the I/O points on Web and Viewpoint Express HMI's.

[Visible \[x\]](#)

Configures which I/O points are displayed on Web and Viewpoint Express HMI's

[Runtime Visible \[x\]](#)

Configures which DI Run Times are displayed on Web and Viewpoint Express HMI's

[Runtime Units \[s\(4\)\].](#)

Four character field to specify the units being displayed on Web or Viewpoint Express HMI's.

[Totalizer Visible \[x\]](#)

Configures which DI Totalizers are displayed on Web and Viewpoint Express HMI's

[Totalizer Divisor \[#####\]](#)

Allow the totalizer to be divided down to a useable units are displayed on Web and Viewpoint Express HMI.

[Totalizer Format \[#\]](#)

Configures the position of the decimal point displayed.

[Totalizer Units \[s\(4\)\]](#)

Four character field to specify the units being displayed on Web or Viewpoint Express HMI's.

[Rate Visible \[x\]](#)

Configures which DI Rates are displayed on Web and Viewpoint Express HMI's

[Rate Numerator \[#####\]](#)

Allows the scaling to the DI Rate Displayed on Web and Viewpoint Express HMI's

[Rate Div / Mult \[#####\]](#)

Allows the scaling to the DI Rate Displayed on Web and Viewpoint Express HMI's

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[Rate Format \[#\]](#)

Configures the position of the decimal point displayed.

[Rate Units \[s\(4\)\]](#)

Four character field to specify the units being displayed on Web or Viewpoint Express HMI's.

[Digital Outputs | ...](#)

HMI Digital Output configuration section.

[Tag Names \[s\(14\)\]](#)

Display names for each of the I/O points on Web and Viewpoint Express HMI's.

[Visible \[x\]](#)

Configures which I/O points are displayed on Web and Viewpoint Express HMI's

[Analog/Universal Inputs | ...](#)

HMI Analog Input configuration section.

[Tag Names \[s\(14\)\]](#)

Display names for each of the I/O points on Web and Viewpoint Express HMI's.

[Visible \[x\]](#)

Configures which I/O points are displayed on Web and Viewpoint Express HMI's

[Scaling Format \[#\]](#)

Configures the position of the decimal point displayed.

[Scaling Units \[s\(4\)\]](#)

Four character field to specify the units being displayed on Web or Viewpoint Express HMI's.

[Totalizer Visible \[x\]](#)

Configures which I/O points are displayed on Web and Viewpoint Express HMI's

[Totalizer Divisor \[x\]](#)

Allow the totalizer to be divided down to a useable units are displayed on Web and Viewpoint Express HMI.

[Totalizer Formats \[x\]](#)

Configures the position of the decimal point displayed.

[Totalizer Units \[s\(4\)\]](#)

Four character field to specify the units being displayed on Web or Viewpoint Express HMI's.

[Analog Outputs | ...](#)

HMI Analog Output configuration section.

[Tag Names \[s\(14\)\]](#)

Display names for each of the I/O points on Web and Viewpoint Express HMI's.

[Visible \[x\]](#)

Configures which I/O points are displayed on Web and Viewpoint Express HMI's

[Scaling Format \[x\]](#)

Configures the position of the decimal point displayed.

[Scaling Units \[s\(4\)\]](#)

Configures the position of the decimal point displayed.

Web User Enables

Status: [x]

Turn on and off the Status Display link in the User Webpage.

Configuration: [x]

Turn on and off the Configuration link in the User Webpage.

DI Totalizer Clear Button: [x]

Turn on and off the ability to clear the DI Totalizers from the User Webpage

DI Runtime Clear Button: [x]

Turn on and off the ability to clear the DI Runtimes from the User Webpage

AI/UI Totalizer Clear Button: [x]

Turn on and off the ability to clear the AI/UI Totalizers from the User Webpage

Status Clear Button: [x]

LCD

BackLight Timeout(S): [#####]

Ascent only. Used for power savings when not using LCD HMI.

Display Timeout: [#####]

Ascent only. Used for power savings when not using LCD HMI.

Contrast: [#####]

Ascent Only. Adjust LCD contrast.

Enable Local Clr/Force: [x]

Ascent only. Allow Forcing and clearing of forcing from LCD HMI.

Enable Remote Clr/Force: [x]

Enable the ability to force and clear forcing from the Local or Remote HMI.

Enable Local Setpoint Edit: [x]

Ascent only. Allow Forcing and clearing of forcing from LCD HMI.

Enable Remote Setpoint Edit: [x]

Enable Setpoint editing on the Local or Remote HMI.

Allow Config Access: [x]

Ascent only. Allow configuration access on the Local HMI

Mirror Remote I/O | ...

This section configures I/O Mirror mode display parameters that will go across the link as volatile. If this is the master, then each of the configurations selected will get sent to the remote slave and displayed there in the format specified on the master unit. This will occur for the Web and Viewpoint Express HMI's. On the slave, the mirrored parameters are volatile. The slave will revert back to its old configuration on a power cycle. The Master will update the slave when communications is reestablished.

Digital Input Mirror Remote I/O

Run Time Units [x]

Enable the transfer of the Digital Inputs Run Time Units string

Totalizer Divisor [x]

Enable the transfer of the Digital Inputs Totalizer Divisor parameter

Totalizer Format [x]

Enable the transfer of the Digital Inputs Totalizer Format parameter

Totalizer Units [x]

Enable the transfer of the Digital Inputs Totalizer Units string

Rate Numerator [x]

Enable the transfer of the Digital Inputs Rate Numerator parameter

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[Rate Div / Mult \[x\]](#)

Enable the transfer of the Digital Inputs Rate Div/Mult parameter. Mode is dependent on whether Rate Slow Mode is enabled or not.

[Rate Format \[x\]](#)

Enable the transfer of the Digital Inputs Rate Format parameter.

[Rate Units \[x\]](#)

Enable the transfer of the Digital Inputs Rate Units string

Analog Input Mirror Remote I/O

[Totalizer Divisor \[x\]](#)

Enable the transfer of the Analog Input Totalizer Divisor parameter

[Totalizer Format \[x\]](#)

Enable the transfer of the Analog Input Totalizer Format parameter

[Totalizer Units \[x\]](#)

Enable the transfer of the Analog Input Totalizer Units string

Remote Visible | ...

If in Master Mode, these enables will choose which of the remote calculated values will be shown on the Web and Viewpoint Express HMI's.

[DI Totalizers \[x\]](#)

Enable the display of the Digital Input Totalizers on the local Web and Viewpoint Express HMI's.

[DI Run Time \[x\]](#)

Enable the display of the Digital Input Run Times on the local Web and Viewpoint Express HMI's.

[DI Rate \[x\]](#)

Enable the display of the Digital Input Rates on the local Web and Viewpoint Express HMI's.

[UI/AI Totalizers \[x\]](#)

Enable the display of the Universal or Analog Input Totalizers on the local Web and Viewpoint Express HMI's.

Master Mode Configuration

[Master Mode | ...](#)

This section configures this unit as a Master I/O Module in a point to point system or as a quiescent I/O transmitter to a Pinnacle Series controller using the SDX protocol.

Port: [dd(4)]

Configure which port on the I/O module to use in Master Mode. Only one port may be used at a time.
Disabled, Ethernet, Serial, Radio.

Send On Change: [x]

Start a new transaction with remote on any I/O change.

Send Analog on Digital Change: [x]

If there is no change in Analog Input values but a Digital Input has changed, send the Analog Inputs anyway.

Destination IP: [xxx.xxx.xxx.xxx]

Used as the destination IP address over Ethernet for all Master Mode messages. Master Mode | Port must be set to Ethernet.

This parameter is also used when Pass Thru Bridging is turned on and an unsolicited message comes in on the serial or radio port If Eth->Radio or Eth->Ser Pass Thru Bridging is turned on respectively.

Destination Name: [s(60)]

Used as the Destination address if DNS is enabled. If the DNS lookup is unsuccessful then the Destination IP is used for any Master Mode messages

SDX Unit ID: [#####]

Global SDX address for this local unit. Applies to all interfaces.
1-65535

Remote ID: [#####]

SDX address Master Mode will use to communication with Remote I/O Module or Pinnacle controller.
1-65535

DNS Server IP: [xxx.xxx.xxx.xxx],

DNS server to use for looking up either the Destination Name or The Dynamic DNS (DDNS) server.

Settings

This section is the general communications settings for Master Mode communications.

Polling Time (S): [#####]

How often to blindly initial a transactions. Best practice: making this time long and use the On Change configurations to configure which data is most important to get immediately. This can save a lot of communication bandwidth over radio networks.

Retrigger Holdoff Time (x100mS): [#####]

Configure this to inhibit On Change configurations from send data too fast.

Response Timeout (x100mS): [#####]

Time to wait for a response message from the remote destination.

Retry Count: [#####]

Number of times to retry a message and wait for a response before asserting a communication failure.

Quiet Time x1 mS: [#####]

Amount of time desired to wait after the data medium (radio, serial or Ethernet) has been quiet before attempting a new message. In system where there are multiple masters or a lot of repeater traffic, it is good to configure all units with a slightly different Quiet Time

Radio Wakeup [MM] (x100mS): [#####]

In Master Mode, wake up the radio for this amount of time before transmitting and going back to sleep.
0 = disabled, 1 – 63353 x 100mS (6535 seconds)

Enables | ...

These configuration flags setup which special I/O types come across the link when in Master Mode. The fewer boxes that are checked the smaller the transaction message will be.

From Remote

DI Totalizer: [x]

Enable Remote DI Totalizers to be brought up to the Master.

DI Runtime: [x]

Enable Remote DI Run Times to be brought up to the Master.

DI Rate: [x]

Enable Remote DI Rates to be brought up to the Master.

UI/AI Totalizer: [x]

Enable Remote AI Totalizers to be brought up to the Master.

To Remote

DI Totalizer: [x]

Enable the Master to write DI Totalizers down to the Remote.

DI Runtime: [x]

Enable the Master to write DI Run Times down to the Remote.

DI Rate: [x]

Enable the Master to write DI Rates down to the Remote.

UI/AI Totalizer: [x]

Enable the Master to write AI Totalizers down to the Remote.

Routing

This section applies to SDX over serial or radio only. With SDX routing, every unit is a repeater by default. The repeater information (next Hop and Hop table) are contained in the message for each repeater in the chain to use. This table of Hops only applies to Master Mode. Only Masters can specify a route.

SDX Unit ID: [#####]

Global SDX ID for all interfaces on this local unit.

Hop 1 ID: [#####]

First Hop on the serial or radio network.

Hop 2 ID: [#####]

Second Hop on the serial or radio network.

Hop 3 ID: [#####]

Third Hop on the serial or radio network.

Hop 4 ID: [#####]

Fourth Hop on the serial or radio network.

Remote ID: [#####]

Final Destination SDX ID on the serial or radio network.

I/O Mapping

This section allows the Master Mode configuration to write to and read from I/O that is not directly indexed the same as the local unit. Since it is possible to have multiple Sprite Masters talk to a single Ascent Remote module, this mechanism provides a way to offset registers in the Remote Ascent. This way several Sprite's I/O can be depicted on a single Ascent Combo's I/O.

DI Size: [#####]

Number of DI's in the block to write to the remote.

Local Index: [#####]

Starting Index on the local Master's DI's. The DI's are specially setup to catch change of state when transmitting to a slave. The DO on the slave will reflect changes of state at the polling rate even if the DI changes faster than the polling rate.

Remote Index: [#####]

Starting index on the remote (remember the destination is a remote DO).

UI/AI Size: [#####]

Number of AI's in the block to write to the remote.

Local Index: [#####]

Starting index on the local Master's AI's or UI's

Remote Index: [#####]

Starting index on the remote (remember the destination is a remote AO)

DO Size: [#####]

Number of DI's to get from a remote to place in local DO's.

Local Index: [#####]

Starting index of the local DO's to write to.

Remote Index: [#####]

Starting index of the remote DI's to read from.

AO Size: [#####]

Number of AI's to get from a remote to place in local AO's.

Local Index: [#####]

Starting index of the local AO's to write to.

Remote Index: [#####]

Starting index of the remote AI's to read from.

On Change | ...

Change detection can greatly improve a systems performance while limiting the amount of bandwidth needed to get data and I/O where it needs to go quickly and simply.

UI/AI Delta [#####]

Amount of change needed before sending Analog Input data.

0 - 65535

UI/AI Debounce [#####]

Amount of time a change needs to stay changed before sending data. This can prevent traffic flooding on a radio network even if a system is changing rapidly.

1 – 65535 x 100mS (1 -6553 seconds)

DI On Change [x]

Send DI data when a rising or falling edge is detected.

Ascent Combo I/O Module

Mirror Remote I/O

When in Master Mode, the master can control the configuration of the I/O on the Remote. This is useful as the Remote can be swapped out and the configuration will be downloaded to the new unit when communication is reestablished.

DI Invert [x]

Inverts the state of the incoming Digital Input signal on the remote

Unchecked = Normal, Checked = Invert

Filters [#####]

Delays the change of state of a Digital Input from being recognized until the state has been held for this time on the Remote

0 = disabled, 1 – 65535mS

DI Slow Rate Mode [x]

Use interval math for calculating pulse rates but using the time between pulses to calculate the rate.

Slow Rate Mode is best for use with pulses that are faster than once a minute but slower than once a second on the Remote.

Unchecked = Fast Pulse Rates, Checked = Slow Pulse (interval) Rates.

DO On Time [#####]

If used with no (Hold) Off time, this function provides a one shot of the time specified when the Digital Output register is set to TRUE.

If used in conjunction with the (Hold) Off Time ((Hold) Off Time set to 0), the Digital Output register when turned on will cycle the output on for the On Time then off for the (Hold) Off Time then repeat. Using this functionality, it is possible for the user to control the DO as a Pulse Width Modulated (PWM) output. On Time should not be used in conjunction with the Flash enable.

0= disabled, 1 - 65535 x10mS (0 to 655 seconds)

DO (Hold) Off Time [#####]

If used in conjunction with the On Time, the Digital Output register when turned on will cycle the output on for the On Time then off for the (Hold) Off Time then repeat. Using this functionality, it is possible for the user to control the DO as a Pulse Width Modulated (PWM) output. (Hold) Off Time should not be used in conjunction with the Flash enable.

If used with no On Time specified (On Time set to 0), this function provides a delay of the time specified when the Digital Output register is set to TRUE and when the physical Digital Output is allowed to turn on. In this mode it can be thought of as an on-delay timer for that Digital Output.

0 = disabled, 1 - 65535 x10mS (0 to 655 seconds)

DO Flash [x]

With Flashing enabled on a Digital Output, when the Digital Output register is set to TRUE, the physical output will cycle at the specified DO Flash Rate.

Unchecked = no flash, Checked=flash when DO register is set to TRUE.

DO Recycle Holdoff [#####]

If this value is set, when the DO register goes from TRUE to FALSE, this timer starts running and inhibits the physical outputs from turning on until the timer elapses. Once the timer has elapsed, the DO register may be set to TRUE and the physical output will turn on immediately when called.

0 = disabled, 1-65535 seconds

UI/AI Mode [##]

Selects either 0 =) 0 -20 mA (0-20000) AI Prescaled or 1 =) 4- 20mA (0-16000) AI Prescaled.

If talking to an Ascent Remote, this number should be configured to the desired UI Mode number for the correct sensor.

UI Average [#]

This parameter sets the degree of oversampling in a boxcar average.

0 =Averaging disabled, 1 = 2 samples, 2 = 4 samples, 3 = 8 samples, 4 = 16 samples, 5 = 32 samples

AO Mode [#]

Selects either 0 =) 0 -20 mA (0-20000) or 1 =) 4- 20mA (0-16000).

Control Configuration

[Control | ...](#)

See the [Control](#) section of this manual for more details.

[Alternation/Control Scheme: \[dd\(12\) \]](#)

Selects Alternation and Control Mode of the internal control blocks.

Off, SetPoint FlipFlop, SetPoint Starts, SetPoint Run Time, 3 Flt Up No Alt , 3 Flt Up FlipFlop, 3 Flt Up Starts, 3 Flt Up Run Time, 3 Flt Dn No Alt, 3 Flt Dn FlipFlop, 3 Flt Dn Starts, and 3 Flt Dn Run Time

[SP3/DI3 Shutdown DO1 & DO2: \[x \]](#)

If checked and only a Setpoint mode is selected then SP3 control block and DI3 input will shut down DO1 and DO 2.

[SP4/DI4 Shutdown DO1 & DO2: \[x \]](#)

If checked then SP4 control block and DI4 input will shut down DO1 and DO 2.

[Float Fail Timer \(S\): \[#####\]](#)

If Call 1 or Call 2 or both have been set to TRUE, if no float activity has been seen for this period of time, then the logic will shut down the calls and wait for the next float change.

[Setpoint Control | ...](#)

See the [Control](#) section of this manual for more details on built-in control logic.

[Enable \[x\]](#)

Enable the [Setpoint Control Block](#).

[Mirror DI to DO \[x\]](#)

Takes the state of the Digital Input and writes it to the corresponding Digital Output register

Unchecked = Normal, Checked = Mirror

[Source Type \[x\]](#)

Select AI or AO type input for this Setpoint Control Block. This allows an outside source to write to the AO and have the local box control from the value. The AI or AO source is always the Scaled Value.

Unchecked AI, Checked AO.

[Source Index \[x\]](#)

Select AI or AO index for this Setpoint Control Block. The AI or AO source is always the Scaled Value.

[On Level \[#####\]](#)

If the On Level is less than the Off Level then the output of the SCB will turn ON when the AI or AO is below the On Level.

If the On Level is greater than the Off Level then the output of the SCB will turn ON when the AI or AO is above the On Level

[Off Level \[x\]](#)

If the On Level is less than the Off Level then the output of the SCB will turn OFF when the AI or AO is above the Off Level.

If the On Level is greater than the Off Level then the output of the SCB will turn OFF when the AI or AO is below the Off Level

Miscellaneous Parameters

Misc | ...

Info

Name: (Text)

Serial#: (Text)

Mfg ID (Text)

Software: (Text)

Software Config#: (Text)

Manufacturing Date: (Text)

Factory Cal Date#: (Text)

User Cal Date: (Text)

Security

User Password: [s(8)]

Password for getting into the User Webpage on the unit.

Blank = no password

Config Password: [s(8)]

Password for getting into the Configuration Webpage on the unit.

Blank = no password

Disable Outside HMI Config: [x]

Do not allow user that are not on the local network to access Configuration Web pages. Only user Web pages would be allowed.

AES Encryption Key: [s(16)]

128bit Encryption key. Must match on all units using SDX protocol.

Register Write Key: [#####]

Register value to allow the writing of configuration data over Modbus or SDX.

0-65535.

Power Save

BackLight Timeout (S): [#####]

Time after the last key press on the HMI to turn of the front panel HMI backlight.

AO Power Disable: [x]

Turn off Analog Outputs and AO power supply.

Radio Wakeup [MM] (x100mS): [#####]

In Master Mode, wake up the radio for this amount of time before transmitting and going back to sleep.

0 = disabled, 1 – 63353 x 100mS (6535 seconds)

Demo

Demo Mode Enable: [x]

Cycle DI's at the given rate.

DI Cycle Time (x100mS): [#####]

Rate to cycle DI's when Demo Mode is enabled.

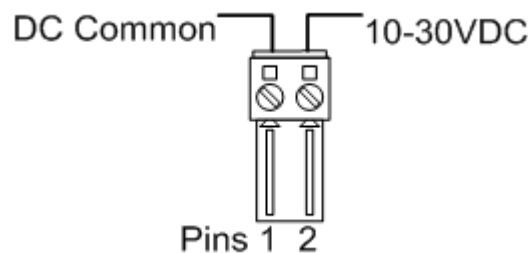
Viewpoint Express Remote HMI



Viewpoint Express HMI with included junction box and mounting tabs

The VP Express offers connection to all ICL products. Sprite, Solaras, Ascent, Pinnacle and Etherlogic product lines can all use the VP Express as a text based interface.

Power Connections



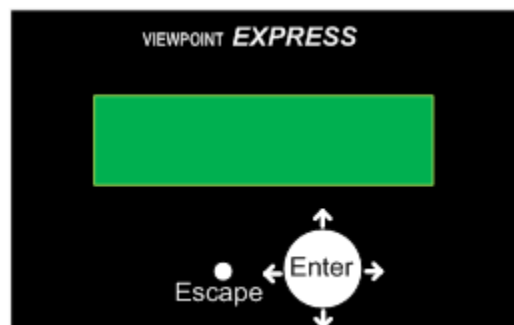
Ethernet Connection

If connecting to an I/O module via Ethernet or serial, the connection typically requires a “straight through” Ethernet cable. The connections on the VP Express are reversed to facilitate quick connection. If connecting Ethernet through a Auto MDX switch, a straight through cable will also work. If connecting to a normal non-Auto MDX switch, an Ethernet crossover cable is required.

Interface and Navigation.

The display is 20 characters across by 4 lines down.

The buttons on the front panel handle all navigation:



Pressing and holding the arrow keys changes pages.

To edit a field, highlight the field and press Enter. Use the up and down arrow keys to scroll through the available values.

Press Enter again to confirm an edit and Escape to cancel any edit.

In navigation, Escape will also take you back menus.

Profile Configuration

The VP Express has 32 communication profiles that can be configured for any type of controller or I/O module. To access the profiles, press and hold the Escape button.

You should see a title like “Profile 01”.

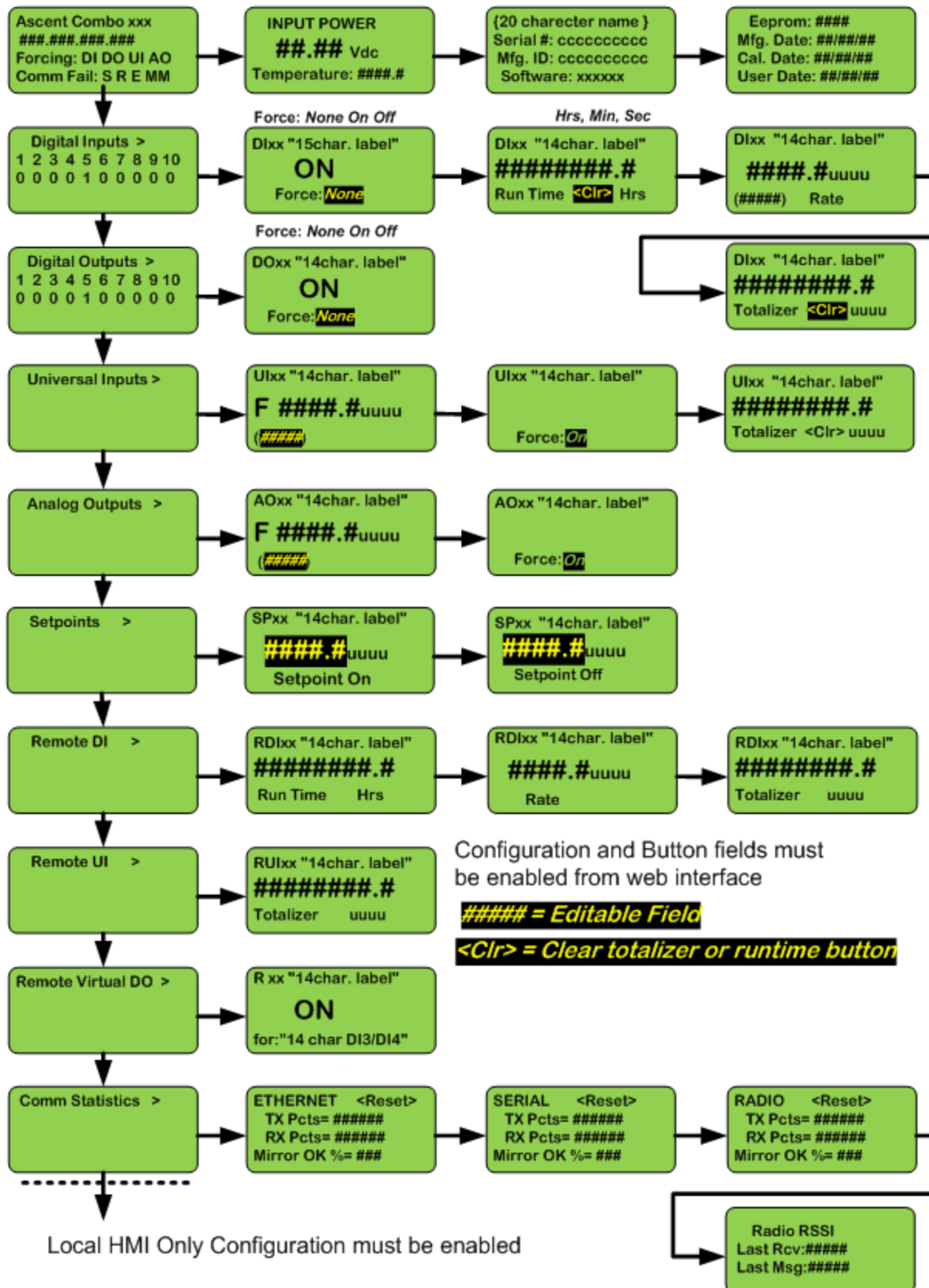
You can use the right and left arrow keys to choose one of 32 profiles. Press the down key to get the first parameter of the profile. To edit a parameter, press Enter, then use the up and down arrows to select the available values, then press Enter again to save the new value.

Menu

Profile Parameters	Options/Units	Explanation
Operation Mode	Pinnacle	Pinnacle Series Controllers: 128bit encrypted Textual User Interface (TUI)
	Etherlogic	Etherlogic Series Controllers: (TUI)
	I/O Module	Sprite, Solaras, and Ascent: 128 bit encrypted SDX
Communication Mode	Ethernet	Ethernet/UDP
	Serial	Optional Serial Port
Remote IP Address	xxx.xxx.xxx.xxx	IP address of controller or I/O module
Port	0-65535	IP Port of hosting controller or I/O module
Network Address	0-65535	Serial SDX protocol address
Non-Profile Parameters		
Enable DHCP	On Off	Turn on or off DHCP, Overrides the Local IP Address only after an IP address is successfully obtained from a DHCP server.
Local IP Address	xxx.xxx.xxx.xxx	IP address of ViewPoint Express
Gateway Address	xxx.xxx.xxx.xxx	IP address of gateway (ie. to the Internet)
Network Mask	xxx.xxx.xxx.xxx	Range of IP addresses on the local and external network
AES Encryption Key	14 chars	128 bit key used with SDX protocols and Pinnacle TUI's. Must match exactly to host unit.
Baudrate	1200-115k	serial option only.
Display Timeout	Seconds	Time to go into low power sleep mode
Update Rate x100mS	100mS increments	Poll rate for I/O module interfaces
Backlight Timeout	Seconds	Time to shut off backlight for power savings
Contrast	Percent	Percentage contrast for LCD display
Mfg Info		Version, Serial Number, Mfg ID, Mfg date

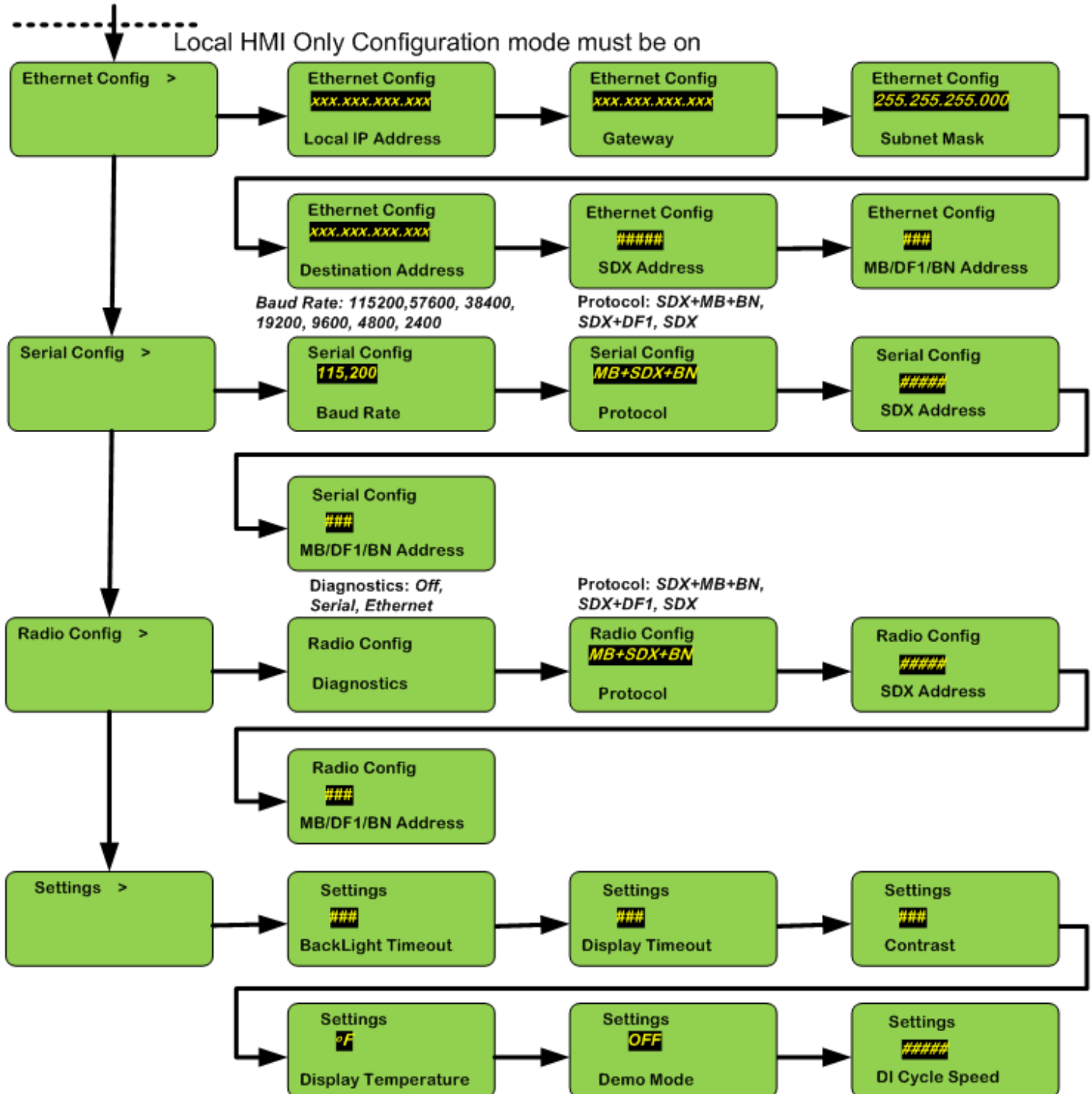
Local and Remote HMI Menus

The menus depicted here are highly dependent on the HMI configurations. The local menus are accessed by the HMI on the Ascent. The remote menus are accessible from a Viewpoint Express as well. The menus are shown in their entirety as though all HMI configuration were turned on. See [HMI Configuration](#) section.



Local Only HMI Menus

The menus depicted here are highly dependent on the HMI configurations. The menus are shown in their entirety as though all HMI configuration were turned on. See [HMI Configuration](#) section. The Ascent comes standard with a configuration and user HMI LCD. These configuration menus are available only on that local display:



Modbus Map

Status Input (1xxxx Boolean Read-Only Registers)

These flags are Read Only Status Bits

Register Range

1–10	Digital Input 1–10
17–26	Digital Input 1–10 Stretched
33–42	Digital Input 1–10 Raw Input (Includes inversion).
49–58	Digital Output 1–10 Relay State DO 1–10 State after the DO Register.
65–72	Setpoint Out 1–8 SP Out 1–8 Output of the Setpoint Control Blocks.
73	Serial Communications Failure
74	Radio Communications Failure
75	Ethernet Communications Failure
76	Mirror Master Communications Failure
77	Forcing Enabled on one or more Digital Inputs
78	Forcing Enabled on one or more Digital Outputs
79	Forcing Enabled on one or more Analog Inputs
80	Forcing Enabled on one or more Analog Outputs

Coil Output (0xxxx Boolean Read-Write Registers)

1–10	Digital Outputs 1–10
11	Virtual Coil 3A
12	Virtual Coil 4A
13	Virtual Coil 3B
14	Virtual Coil 4B
15	Virtual Coil 3C
16	Virtual Coil 4C
17	Virtual Coil 3D
18	Virtual Coil 4D
19	Virtual Coil 3E
20	Virtual Coil 4E
21	Virtual Coil 3F
22	Virtual Coil 4F
25	Clear DI Totalizers
26	Clear DI Run Times
27	Clear AI Totalizer
33–42	Digital Output Flash 1–10
49–58	Mirror Remote Digital Output Flash 1–10
Protected Registers (See Holding Registers for)....:	
65–74	Force Enable Digital Output 1–10
81–90	Force Value Digital Output 1–10
97–106	Force Enable Digital Input 1–10
113–122	Force Value Digital Input 1–10
129–138	Digital Input Invert 1–10
145–154	Mirrored Digital Invert 1 - 10
177–186	Digital Input Slow Rate Mode 1–10
193–202	Mirrored Digital Input Slow Rate Mode 1–10
209–216	Link Universal Input 1-8 to Analog Output 1-8
217–224	Universal Input Force Enable

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225—232	Analog Output Force Enable
233—242	Enable Set Digital Output on Communication Fail 1–10
249—258	Value Set Digital Output on Communication Fail 1–10
265—272	Enable Set Analog Output on Communication Fail 1–8
273—280	Enable Setpoint Control Block 1–8
281—288	Enable Digital Input to Digital Output Mirror 1–8
289—296	Setpoint Source Type Selector 1–8 FALSE = AI, TRUE = AO
297—306	Enable Send Digital Input On Change 1–10
313	Enable Demo Mode
314	Enable WAN Configuration Security (TRUE = LAN only)
315	Enable Serial to Radio Bridging Mode
316	Respond to Bridge port UDP messages with the Bridge port number.
317	Enable RSSI 9600Baud/-110dB mode
318	Enable HMI Setpoint Editing
319	Disable Analog Output Power
321	Enable HMI Clear Buttons
322	Enable Extended Configuration Mode
323	Enable Master Mode Send On Change.
324	Sample Universal Inputs on DI Change.
325	Master Mode include Local DI Totalizers
326	Master Mode include Local DI Run Times
327	Master Mode include Local DI Rate
328	Master Mode include Local AI Totalizers
329	Master Mode include Remote DI Totalizers
330	Master Mode include Remote DI Run Times
331	Master Mode include Remote DI Rate
332	Master Mode include Remote UI Totalizers
333	Select Temperature FALSE = C TRUE = F
335	SP3/DI3 Shutdown DO1 & DO2
336	SP4/DI4 Shutdown DO1 & DO2
337	Enable Remote HMI Buttons
338	Enable Remote HMI Setpoint edit
339	Use Dynamic Host Control Protocol (DHCP)
340	Use Dynamic Domain Name Servers (DDNS)

Input Registers (3xxxx 16 and 32 Bit Read-Only Registers)

1—8	Universal Input Calibrated Raw 1—8
9	DC Power In x10
10	Digital Input 1–10 packed = DI bits 9, 8, 7, 6, 5, 4, 3, 2, 1, 0 = DI 10, 9, 8, 7, 6, 5, 4, 3, 2, 1
11—18	Universal Input Scaled 1—8
19—28	Digital Input Rate 1–10
29—38	Digital Input Interval 1–10
39—54	Scaled UI Totalizers 1—8 (32 bit LSB First)
55—70	Scaled Remote AI/UI Totalizers 1—8 (32 bit LSB First)
71—90	Scaled DI Totalizers 1—10 (32 bit LSB First)
91—110	Scaled Remote DI Totalizers 1–10 (32 bit LSB First)
111—120	Scaled DI Rate 1–10
121—130	Scaled Remote DI Rate 1–10
131—150	Scaled DI Runtimes 1–10 (32 bit LSB First)
151—170	Scaled Remote DI Runtimes 1–10 (32 bit LSB First)
171—178	Scaled Analog Output 1—8

179—186	Calibrated Raw Analog Output 1—8
187—194	Remote AI Mode To Analog Output 1—8
195	Serial Master Mode Percentage Communications
196	Radio Master Mode Percentage Communications
197	Ethernet Master Mode Percentage Communications
198	Serial Last Received ID
199	Radio Last Received ID
200	DC Power In x10
201	Digi Radio RSSI Live Level
202	Digi Radio RSSI Latched Level
203	Last SDX / DDNS Error Code
204	Display Temperature C or F
203	Temperature C

Holding Registers (4xxxx 16 and 32 Bit Read-Write Registers)

1—8	Analog Output 1—8
9	Digital Output 1—10 packed = DO bits 9, 8, 7,6, 5, 4, 3, 2, 1, 0 = DO 10, 9, 8, 7,6, 5, 4, 3, 2, 1
11, 12	Ethernet Transmitted Packets (32 bit LSB First)
13, 14	Ethernet Received Packets (32 bit LSB First)
15, 16	Serial Transmitted Packets (32 bit LSB First)
17, 18	Serial Received Packets (32 bit LSB First)
19, 20	Radio Transmitted Packets (32 bit LSB First)
21, 22	Radio Received Packets (32 bit LSB First)
23—42	Raw DI Totalizers 1—10 (32 bit LSB First)
43—62	DI Run Times 1—10 (32 bit LSB First)
63—78	UI Totalizers Output (32 bit LSB First)
79—88	Digital Output PWM On 1—10 x10mS
89—98	Digital Output Mirror PWM On 1—10 x10mS
99—108	Digital Output PWM Off 1—10 x10mS
109—118	Digital Output Mirror PWM Off x10mS
119	Modbus Configuration Protection Register—12345 = Unlocks Holding Registers above 119
120	UI Totalizer Gate Time in Seconds
121	DI Rate Gate Time in Seconds
122	DI Stretch Time in 100mS increments
123	DO Flash rate (x 0.01Sec)
124—131	Force Value Universal Input 1—8
132—139	Input Mode Universal Input 1—8
140—147	Input Mode Mirror Universal Input 1—8
148—155	Speed Select Universal Input 1—8
156—163	Speed Select Remote Universal Input 1—8
164—171	Averaging Universal Input 1—8
172—179	Averaging Mirror Universal Input 1—8
180—187	Totalizer Divisor Universal Input 1—8
188—195	Totalizer Divisor Mirror Universal Input 1—8
196—203	Totalizer Display Format Universal Input 1—8
204—211	Totalizer Display Format Mirror Universal Input 1—8
212—219	Scaling Numerator Universal Input 1—8
220—227	Scaling Divisor Universal Input 1—8
228—235	Scaling Offset Universal Input 1—8
236—243	Display Format Universal Input 1—8
244—251	Force Value Analog Output 1—8

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252—259	Mode Analog Output 1—8
260—267	Mode Remote Analog Output 1—8
268—275	Display Numerator Analog Output 1—8
276—283	Display Divisor Analog Output 1—8
284—291	Display Offset Analog Output 1—8
292—299	Display Format Analog Output 1—8
300—309	Filters Select Digital Inputs 1—10
310—319	Filters Select Remote Digital Inputs 1—10
320—329	Totalizer Divisor Digital Inputs 1—10
330—339	Totalizer Divisor Remote Digital Inputs 1—10
340—349	Totalizer Display Format Digital Inputs 1—10
350—359	Totalizer Display Format Remote Digital Inputs 1—10
360—369	RunTime Units Select Digital Inputs 1—10
370—379	RunTime Units Select Remote Digital Inputs 1—10
380—389	Rate Numerator Digital Inputs 1—10
390—399	Rate Numerator Remote Digital Inputs 1—10
400—409	Rate Divisor / Multiplier Digital Inputs 1—10
410—419	Rate Divisor / Multiplier Remote Digital Inputs 1—10
420—429	Rate Display Format Digital Inputs 1—10
430—439	Rate Display Format Remote Digital Inputs 1—10
440—449	Output Holdoff Time Format Digital Outputs 1—10
450—459	Output Holdoff Time Format Remote Digital Outputs 1—10
460—467	Master Mode Trigger Delta Universal Input 1—8
468—475	Master Mode Trigger Debounce Universal Input 1—8
476—483	Communications Fail Value Analog Output 1—8
484—491	On Level Setpoint 1—8
492—499	Off Level Setpoint 1—8

Technical Specifications

CPU & Memory

Processor Main CPU

8-bit RISC, 32MHz

Memory

8K RAM

8KB FRAM non-volatile memory

Flash 128K

Inputs and Outputs

Universal Inputs

Quantity	8
Resolution	16-bit
Averaging	"box car" averaging - up to 32 samples per channel, individually user configurable
Measurement modes	0 to 20mA +/- 0 to 250mV 0 to 2V +/- 10V (w/optional interface module) Resistance: 0 to 65535 ohms Thermistor (10K, Type II or III) Thermocouple (type J, K, T, E, R, S, B, N) RTD (10ohm-Cu, 100 & 1K ohm-Pt, 2-wire & 3-wire – 3-wire RTDs require two inputs each) Contact closure
Accuracy	FS = Full Scale 20mA, V: +/- 0.01% FS at 25°C (77°F), +/- 0.02% FS over full ambient temp Ohms: <= 10K ohms: +/- 0.1% FS over full ambient temp > 10K ohms: +/- 0.5% FS over full ambient temp Thermistor +/- 2°C at 25°C (77°F), +/- 5°C over full ambient temp TC +/- 2°C at 25°C (77°F), +/- 5°C over full ambient temp RTD (3-wire) +/- 1°C at 25°C (77°F), +/- 2°C over full ambient temp
Speed (samples/sec.)	Up to 2,500

Analog Outputs

Quantity	8
Output Type	0 to 20mA, 4 to 20mA
Resolution	12-bit
Accuracy	+/- 0.1% FS at 25°C (77°F), +/- 0.2% FS over full ambient temperature range
Maximum Load	1,000 ohms

Discrete Inputs

Quantity:	10
Input Type	12/24Vdc/Vac or 120/240Vdc/Vac (opt)
Input Current	1.2mA@12Vac or 120Vac
Response Time:	10mS1

Discrete Outputs

Quantity	10
Type	Normally Open (Form A) bifurcated relay contact
Rated current	Up to 3A (continuous)
Rated voltage	Up to 240VAC (277VAC maximum switching voltage)
Breaking Capacity	750VA maximum
Minimum contact load	5V / 1mA

Communications, Networking & HMI

Serial Ports

Number of serial ports	1 serial RS-232/RS-485 shared
Spread Spectrum radio option	Digi Xtd, MDS, Freewave
Protocols:	Modbus RTU, DF1, Bricknet, SDX

Ethernet

Quantity	1
Type	10 BaseT
Protocols:	Modbus TCP/UDP, HTTP, IP, ARP, UDP, ICMP, Telnet

Ascent Combo I/O Module

Internal Radio Options

Type	Spread Spectrum, frequency hopping,
Operating Frequency	902MHz to 928MHz
RF Power (maximum)	1Watt
Data Rate (maximum)	115K baud
Radio Brands	
Freewave:	Sensitivity: -108dBm (BER 10 ⁻⁶), 32-bit CRC, point to multipoint, net diags, FGR-115 compatible Adds 0.2W @ 12Vdc input power
Microwave Data Systems	Sensitivity: -108dBm (BER 10 ⁻⁶), 16-bit CRC, point to multipoint, net diags, Transnet compatible Adds 2.5W @ 12Vdc input power
Digi/Maxstream	Sensitivity: -110dBm @9600 baud, -100dBm @115K baud, point to multipoint & peer to peer, DigiMesh Adds 1.2W @ 12Vdc input power

General

Local HMI

Display	122x32 Graphic LCD w/LED backlight (4 lines x 20 characters max. in small font character mode)
User Input	5 Axis navigation Switch plus "Escape" pushbutton switch

Terminal Blocks

Removable, 5.02mm (0.2"), 12 to 22AWG, 15A/contact maximum

Mounting

Panel or 35mm. DIN rail

Dimensions

6.2"W x 3.0"H x 6.2"D

Environment

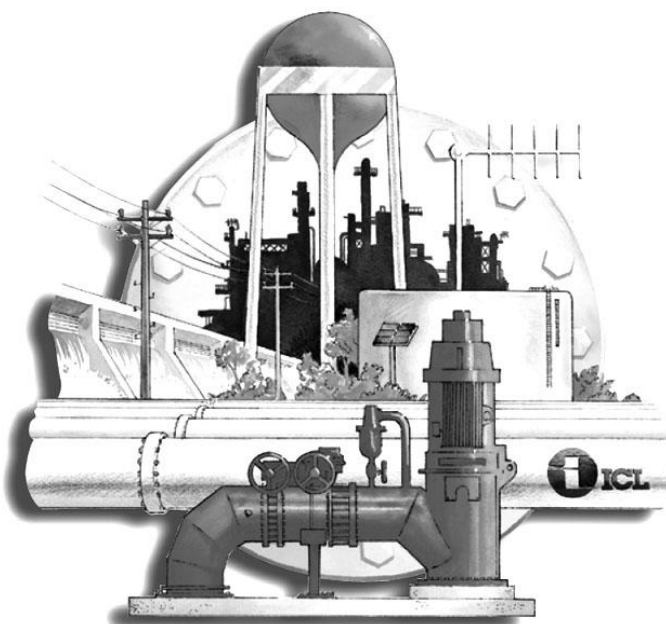
- 40°F (- 40°C) to 158°F (70 °C), 5% RH to 95% RH, non-condensing

Power

	10 to 30Vdc
Low Power Mode	@12V 8MHz Low Power Mode Ethernet OFF and Backlight OFF 0.44W
Normal Power Mode	@12V 32MHz Backlight OFF Ethernet ON 1.33W
Additional Power Usage	Add 0.25W when the LCD backlight (internal HMI) is ON Add 0.1W per Discrete Output Relay turned ON Add 0.1W (Analog Output Power enabled) + 0.6W per Analog Output @ 20mA out See Internal Radio Options section for additional power usage

Warranty

3 years, factory parts and labor



Industrial Control Links, Inc.
12840 Earhart Ave.
Auburn, CA 95602
Telephone: (530) 888-1800
Fax: (530) 888-7017
E-mail: support@iclinks.com
Web-site: www.iclinks.com

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